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UNIVERSITY OF ALBERTA

AN EVALUATION OF TECHNICAL EQUIPMENT USED BY STUDENTS WITH VISUAL IMPAIRMENTS

BY

DIANNE MCCONNELL

A THESIS

SUBMITTED TO THE

FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF

THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF EDUCATION IN SPECIAL EDUCATION
(SEVERE DISABILITIES)

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

Fall, 1993

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ISBN 0-315-88293-X

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "An Evaluation of Technical Equipment used by Students with Visual Impairments", submitted by Dianne McConnell in partial fulfilment of the requirements for the degree of Master of Education.

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Dr. Eugene Lechelt

Date: Sept. 1, 1993

ABSTRACT

The literature revealed that technology is presently being used in programs that integrate students with visual impairments. A number of questions immediately come to mind specific to the equipment that is being used. What kinds of technical equipment is presently being used? What is the function of this equipment, and is this equipment being used to maximize the learning of this student population? The purpose of this study is twofold: (a) to develop an assessment tool, taking into account student characteristics, program characteristics and characteristics of the equipment; and (b) to use this assessment tool to evaluate technical equipment for the blind and visually impaired. Agencies that distribute technical equipment for the blind and visually impaired were contacted and a request was made for information specific to the function of their equipment and prices of their products. From the literature that was received, the kinds of equipment available was listed and grouped into categories based on the function of the equipment.

A review of the literature was made to determine the characteristics of students with a visual impairment in an integrated educational classroom. As well, the characteristics of the programs that these students were integrated into were considered.

Characteristics of the equipment, characteristics of

the student, and characteristics of the program, were developed into evaluation criteria which were represented in a three part assessment tool. This assessment tool was used to evaluate each piece of equipment from the list that was generated.

Evaluation data resulting from the application of this tool to specific pieces of equipment were summarized and interpreted in order to provide tentative answers to the questions that were asked initially. This research is unique in that the technology was evaluated in terms of student and program characteristics, in addition to characteristics of the equipment. It is hoped that the assessment tool will be helpful to school systems when they are in a position of deciding which piece of technical equipment they will purchase on behalf of a student. Also, this tool would assist professionals in the evaluation of newly developed technology and offer feedback to the manufacturers.

ACKNOWLEDGEMENTS

I would like to thank my thesis advisor, Dr. Linda McDonald, for her patience, support and encouragement as I worked my way through this project. Dr. McDonald has been an excellent role model and mentor for me and I respect her tremendously. Thank you to Dr. David Baine, not only for participating on my committee, but also for the investment of his time and expertise in the development of the assessment tool. Thank you to Dr. Eugene Lechelt for participating as a committee member and supporting me with his kindness and insight. I value his commitment to the population of children with visual impairments.

Thank you to my husband, Roy, who supported this project unconditionally. His love, continual encouragement and perspective in quality of life, offer leadership to our family that we all benefit from. My children, Maren, Erik and Ben, and grandma, are to be thanked for respecting the sanctity of "the den".

Thank you to my friends and professional associates who continually offered support during the past three years. In particular, I would like to acknowledge my son Benjamin and my student James for their love of life and their desire to "find out". My relationship with these boys has made me realize what priorities in life should be. Professionally, I am unconditionally committed to making a contribution to the

education of children with visual impairments. Special thank you to Linda Stainton and Brian Henschel, my associates, for their support in this project. I would also like to acknowledge the contribution that they have made and continue to make in the education of children with visual impairments. Many, many children have benefited because of their efforts and expertise in the field.

Darlene Tanchuk is a personal friend and associate whom I would like to recognize at this time. I first met Darlene in the Masters program and since then she has become a very close personal friend. I respect her level of expertise in the work that she does and value her friendship. Thank you Darlene.

Kenn Juchli is a treasured friend whose commitment to children with visual impairments is unconditional. He is one of the most caring and generous individuals that I have known. Many children will benefit from his hard work. Thank you Kenn.

Finally I would like to thank the manufacturers and/or distributors who responded to my request for information. I hope that the information gained from this study is helpful in your pursuit to service the population of individuals with visual impairments.

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CHAPTER ONE

Introduction

Visual impairment is a general term which applies to a very large spectrum of visual loss, from very good residual or functional vision to complete blindness (Scholl, 1986). Research indicates that visual impairments evokes more awkwardness in people without disabilities, than any other disability (Hallahan & Kauffman, 1988). It has been suggested that this awkwardness has evolved from individuals' experiences with a person who is blind or from what they imagine blindness would be like for themselves. Resulting attitudes and beliefs influence their relationships with persons who are blind (Scholl, 1986).

This attitude directly correlates with expectations that people have of individuals with visual loss. For example, if people believe that completing a task without vision is impossible, they assume that the completion of that same task by an individual with vision loss is nothing short of miraculous. Lack of expectations in an educational placement can drastically influence the acquisition of normality for the student who is blind.

Normalization is the philosophical belief that every disabled person should have an education and living environment as close to normal as possible. Wolfensberger (cited in Snell, 1993) defined normalization as:

"utilization of means which are as culturally normative as possible, in order to establish and/or maintain personal behaviours and characteristics which are as culturally normative as possible" (p.92). Regardless of the type or level of the individual's disability, normalization dictates that he or she should be integrated as much as possible into the larger society (Hallahan & Kauffman, 1988).

During the last decade, integration has become a reality as a result of pressure from parents, advocacy groups, and professionals who have influenced educational trends. Integration is defined as the placement of children with disabilities into the mainstream of regular educational programs (Scott, Jan, & Freeman, 1985). Presently, there is no residential school serving children with visual disabilities, in Alberta. Typically, children with a single sensory impairment of vision loss are educated in integrated classrooms.

Bower (cited in Tuttle, 1986) reported that the goal of education is to assist children and youth to acquire life competencies would enable them to love, to work, and to play. To achieve this goal, one must recognize that students have individual differences which can be expressed through learning styles, interests, source of motivation, environmental influence, family support or limitations. These individual differences require modifications of curriculum, learning strategies, materials or devices,

classroom management, or environment, if educators are to successfully meet the unique needs of students (Tuttle, 1986).

Students with a vision loss are disadvantaged in an educational placement because of their inability to access visual information that is presented. Depending on the vision loss of the student, equal access to information may involve: (a) transcribing regular print materials that the teacher has prepared for the students into braille or large print; (b) facilitating access to maps and pictures by accessing models or real objects to accommodate tactile exploration; and (c) preparing an auditory description of films and/or other visual aids that the teacher may be using to complement his/her teaching. These processes may be formidable tasks when one considers the volume of visual information present within the walls of one classroom.

Presently, educational programs, in Alberta, access braille, large print, and auditory reproductions of curriculum materials from the Multi-Media Resource Center, a service of the Alberta Government. Materials that are classified as teacher prepared or enrichment must be changed into a functional media for student use within individual classrooms. Usually, if the student has a significant vision loss and particularly if that vision loss warrants the use of braille, the teacher requires assistance from a full-time teacher-aide who manages the production of materials.

The production of classroom materials is very time consuming. As a result, the materials that are adapted for use by the student with a vision loss, to offer enrichment and extension, is not often available. For example, the teacher will give the teaching assistant assignments, worksheets, notes and so on, which he/she will be using on a given day as teaching materials for the students. The teaching assistant uses his/her paid time to transcribe or adapt these materials for the student with a visual impairment. During the lesson time, the teaching assistant is present to spend time with the student having a visual impairment and to clarify visual materials that the teacher is using with the other students. After class, the teaching assistant must collect the daily assignments from the student and transcribe or adapt these materials into a format that allows the teacher to read what the student has written. If the student answered his/her homework in braille, the teacher assistant would transcribe this homework into print. This process fills the time available in the school day and does not allow for the modification of materials that the teacher brings into the class for extra practice or additional interest. The student with a visual impairment in this situation does not have equal access to classroom information. For this reason, more and more teachers are making an effort to incorporate technology into these programs to address the issue of equal access to

information.

Specialized technology has been developed to assist in the production of materials for use by students with vision loss. The pace of technological development has been rapid over the past few years, and one can only expect that more and better tools and technologies lie ahead (Schreier, 1990). As a result, it is inevitable that technology will be present in programs integrating children with a visual impairment.

A host of new technology for blind and low vision students is emerging. Advances in computer technology and electronics have the potential for giving a student with a visual impairment almost total access to the printed and electronic word (Todd, 1986). The parents and the school staff must work cooperatively to identify and obtain all necessary resources. An example of an obtained resource is consultation from a teacher trained in the education of students with visual impairments. The consultant, school staff, and parents cooperatively determine the educational goals for the student and develop these goals into a working document. In some school jurisdictions, this document is called the Individual Program Plan (IPP) or Individual Education Program (IEP).

Before specialized equipment or materials are selected for the student with a visual handicap, the teachers must investigate all aspects for the use and applications of

equipment, in order to ensure that it is appropriate for the student and that it can assist in meeting the goals outlined in the student's IPP (Todd, 1986). Presently, an evaluation tool is not available to teachers to facilitate this investigative process. Typically, school staff are dependent on information accessed from the vision consultant, if the school has access to one. The vision consultant offers information based on training and experience in the field. In Alberta, experience with specialized equipment may be very limited because the equipment is not manufactured locally and consultants must rely on professional development or information obtained from the manufacturers to gain their information. Without an assessment tool, consultants or teachers may acquire limited or inappropriate information which may result in a piece of equipment accessed for an individual student which sits on the shelf.

The purpose of this research is twofold: (a) to develop an assessment tool based on student characteristics, program characteristics, and technical characteristics of the equipment; and (b) to use this assessment tool to evaluate technical equipment for the blind and visually impaired.

Tool development

According to the literature, examples of student characteristics to be included are: (a) age; (b) disabilities; (c) abilities; and (d) specialized skills that the student has or will need to use the equipment

successfully. Program characteristics, to be considered fell into one of three categories: (a) curriculum methods, (b) teacher methods; and, (c) instructional methods. Questions from this section focus on the function of the equipment across grade levels and subject areas. Technical characteristics are divided into categories based on the function of the equipment and the policies and practices of the manufacturers supplying the equipment. These categories included: (a) general technical characteristics; (b) input functions; (c) output functions; and (d) voice synthesis. Input functions were further subdivided to include characteristics of large print software, computers and braille software. Output functions were subdivided to include sections on characteristics of the computer screen and refreshable and hardcopy braille equipment. The assessment tool was developed from characteristics within each of these categories.

Application of the tool

The assessment tool developed within this research was applied to equipment which is available to students with visual impairments. Twenty-six reputable companies that manufacture and/or distribute specialized equipment for use by individuals with blindness or some significant degree of vision loss, were contacted for information that they used to market their products. The expectation was that this information would come in the form of advertising brochures,

sales catalogues, and price lists. This information was used to make a list of available products and to answer assessment questions during the evaluation.

Significance of study

This study is significant because an assessment tool has been developed that evaluates specialized technical equipment from an educational perspective. Student and program characteristics have been taken into consideration along with technical characteristics of the equipment. Information from the use of the assessment tool provides those individuals involved in the evaluation of equipment with an idea of the versatility of the equipment when used in the school classroom. It is hoped that the information obtained from this study will assist in making decisions about the most appropriate and effective technology for students with visual needs. Barraga (1986) summarizes this concept beautifully when she states:

> "The important thing is for teachers neither to accept nor reject any device or piece of technical equipment without careful evaluation of its characteristics, consideration of how it can facilitate the accomplishment of objectives for individual students, and to develop software and programs designed to further educational goals....No piece of equipment or machine is of value in and of itself; the value lies in how well it permits the user to achieve her objectives by the use of technology." (p.98)

A tool of this nature has not been available for teacher use thus far.

A second reason that this study is significant is that the assessment tool pinpoints those areas that teachers

consider when they purchase equipment. If the manufacturers are aware of what information is needed, in the schools, they will be able to provide this information in the marketing information that is sent out. With the acquisition of this information in the schools there is the possibility of positive implications for the manufacturers through sale of equipment. Teachers and school systems will be more inclined to purchase equipment if they feel secure that educational objectives can be met.

The development of this tool and the application of it follows in chapters 2, 3 and 4. Chapter 2 is the review of literature and establishes the presence of technology in the school environment. Integration of students with special needs is discussed and characteristics of student, program and technical equipment are reported. Chapter 3 includes information on the participants of the study, the technology reviewed, evaluation characteristics and data analysis. Chapter 4 include the results and discussion of the study.

CHAPTER TWO

Review of the Literature

The following review of the literature examines characteristics of students with visual impairments, programs, and technology, which need to be taken into consideration prior to the placement of specialized technical equipment into integrated classrooms. Topics discussed include: (a) presence of technology; (b) integration of students with visual impairments; (c) characteristics of students with visual impairments; (d) characteristics of programs which include students with visual impairments; and (e) characteristics of technical equipment.

Presence of Technology

Riddel (1989) stated that: "Technology is defined by the Oxford Dictionary as 'a study or use of the mechanical arts and applied sciences'; not merely electronics" (p.80). Fifteen years ago, electronic technology for persons with visual impairments, meant simply closed circuit television resulting in minimal magnification improvements and minimal flexibility (Riddel, 1989). Within the last 15 years, computers have facilitated dramatic changes in the business world. Access technology, in conjunction with computers,

have the potential to reduce the impact of visual losses on the population with visual impairments. Access technology refers to equipment and peripherals developed to allow persons with a visual impairment to use technology presently being used by the sighted public (Uslan, 1992).

Literacy has been defined as, "communication with written graphic symbols- that is, gaining meaningful information through reading and conveying meaningful information through writing" (Koenig, 1992, p. 277). The ability to gain and convey information in meaningful ways is an indispensable component of literacy. Technology will likely increase literacy among individuals with visual impairments, but it is not a distinct component of it (Mack cited in Koenig, 1992).

Scadden (1984) forecasted that the vast majority of employment and educational tasks, and a growing proportion of leisure activities as well, will involve the creation, processing, and distribution of information. He discussed the implications of a technological movement for a person with a visual loss, and suggested that a transfer of information will occur with the assistance of technical devices.

> "Computers have neither prejudice nor preference. The computer user may have any colour, religion, national origin or physical characteristic. The information presented can be visual, tactile, or auditory. For the first time since civilization abandoned the oral tradition of information dissemination in favour of the benefits provided by literacy and the written word, blind people may achieve equality in the access to

information" (p. 394).

Technology relates specifically to those devices developed for use by the population of visually impaired individuals to access information. This technology does not have to be electronic in function.

Children must develop four communication skills in order to function effectively in a literate society: (a) speaking; (b) listening; (c) reading; and (d) writing. Koenig, Mack, Schenk, and Ashcroft (1985) stated that computer skills must be added to this list. As the focus on computer skills becomes more intense, technical devices and systems will play an increasingly important role in visually impaired persons' lives (Lindstrom, 1990). Within the past decade, advances in computer technology, electronic communications, and information processing have revolutionized the way blind people can gather information (Dixon & Mandelbaum, 1990). Dixon and Mandelbaum (1990) pointed-out that although there are many different avenues for improving access to printed materials, the pace of development continues to be tremendous. One can only expect that more and better tools and technologies lie ahead.

Technology has indeed become part of educational programming for students with visual impairments. Mack, Koenig, and Ashcroft (1990) stated that microcomputers are powerful tools for students who are blind or visually impaired. These tools can make the difference between equity

and inequity in school and between employment and unemployment. According to Luxton (1990), once an individual becomes literate in adaptive computing, learning becomes a simpler process. Just as anyone uses the tools of reading and writing, to learn to accomplish tasks, a computer-literate individual with a visual impairment can, other things being equal, use that new capability to move along any path that interest or opportunity suggests.

The presence of technology in educational programs for the visually impaired is recognized by the CARROLL CENTER for the BLIND, in Newton, Massachusetts. This center initiated a new service in 1988, that allows Massachusetts schools to borrow adaptive computer devices for their students who are blind (Rosenbaum, 1990). This service was developed as a result of perceived technological needs of teachers of the visually impaired, the students with a visual impairment, and their programs. The center reasoned that if the teachers and students were allowed reasonable access to the present technology, the purchase of this equipment would be facilitated (Rosenbaum, 1990). Brian Charlson, a senior instructor at the Carroll Center, expanded on the services of the Carroll Center in his article "Project Cable: A Place to Train People" (Charlson, 1992). Project Cable is a training program for teachers and students who will be using technical equipment developed for students with visual impairments. Students learning to use

computers to help them with their education, perform their jobs, and access the written word on-line soon discover that with an investment of time and energy, the computer could be a tool of equality. A component of the Center's service involves an individualized evaluation of technology for individual use. This project recognizes that technology played an important role in educating students with a visual impairment.

Universities and colleges are responding to the prevalence of technology in our world today. Head and Bishop (1992) reported on a survey of university and college programs to determine strategies for preparing teachers of children with visual impairments. This survey revealed that types of courses varied across programs, with the most prevalent courses being physiology of the eye, braille, orientation and mobility, curricular modifications, and specialized technology.

The literature reviewed establishes the use of specialized technology by students with visual impairments. University programs, established to train teachers of children with visual impairments, have responded by exposing these teachers to the use of specialized technology. The regular classroom teacher, in all liklihood, did not take these courses either because this program was not offered at their institute of training or they were not required as part of their program. As a result, many children with

visual impairments, are integrated into Alberta classrooms with teachers who have not had exposure to specialized technical equipment. This situation has the potential to create difficulties for the students with visual impairments and for their teachers. These difficulties are discussed in the following section.

Integration of Students with Special Needs

The purpose of education is to equip all children and youth with life competencies that enable them to love, to work, and to play within the context of an acceptable system of values (Tuttle, 1986). Children and youth with disabilities have unique needs which prevent the attainment of these competencies through ordinary provisions of general education. Special education programs were developed to address these individual needs in the pursuit of attaining these competencies. Stainback, Stainback, & Bunch (1989) have reported that general education in effect has been operated as a "dual system" of education. This "dual system" of education has special education and regular or general education operating side by side, each with their own pupils, teachers, supervisory staff and funding system.

The Bill of Rights passed in 1958, made provision for specific rights to individuals within Canadian federal jurisdiction. Since that time educational experiences of individuals with exceptional or disabling conditions have facilitated changes in educational policy and direction

(Kysela, French, & Johnston, cited in Stewin & McCann, 1987). One of the most dramatic changes has been the development of educational programmes which facilitate 'normalization'.

Wolfensburger (cited in Hallahan & Kauffman, 1988) has popularized the belief that every handicapped person should have an educational and living environment as close to normal as possible. This philosophy has become associated with the term, 'normalization'. Many professionals have viewed 'mainstreaming', as the primary method by which schools can help exceptional children achieve normalization (Hallahan & Kauffman, 1988). Mainstreaming has been defined as, "the temporal, instructional, and social integration of eligible exceptional children with normal peers on an ongoing, individually determined educational planning and programming process" (Kauffman, Gottlieb, Agard, & Kukic, cited in Bailey and Wolery, 1984, p. 109). Mainstreaming has been used synonymously with the term integration. Flynn and Kowalczyk-McPhee (1989) define integration as something that has been made whole by uniting different parts.

Integration has resulted from an attempt to reduce the dichotomous effect of a dual system of education (Stainback et al., 1989). The reality of the situation is that unless the school system has adopted the philosophy of regular education these integrated students are still classified as special education students. Regular education for all is

based on several assumptions about people and learning. First, each child has the right to belong and should be welcomed as a full member of his or her neighbourhood school. Secondly, each child has the right to grow and develop with relationships with peers who have diverse skills. A third assumption is that schools should strive to be communities that value diversity. A final assumption is that people need to dream and to express what they hope for the future (Forest & Lusthaus, 1989).

Educating students in regular education is controversial because it raises deeply provocative educational and social issues (Forest & Lusthaus, 1989). The Provincial Executive Council of the Alberta Teachers Association resolved to develop and publicize a comprehensive position on, and strategies for dealing with, the combination of emerging trends in curriculum, methodology, and organization which are imposing unsound educational practices on teachers and creating conflicting and unreasonable expectations of public education (Committee on Public Education and Professional Council, 1993). This committee invited teachers, administrators, school representatives, local secretaries and interested individuals to respond to several issues specific to recent trends and initiatives in education. One of these trends is integration. Generally speaking, the submissions responding to integration issues expressed a deep concern that in too

many cases the process is not working, and in fact creating educationally unsound situations. These responses cited problems with implementation, lack of necessary support, good idea for some but not for others,, lack of essential training for "regular" teachers, lack of inservice training, impact of these practices on "regular" students, failure to meet the needs of either "special needs" or "regular" students, medical aspects, teachers in a "no win" situation, and, cost/benefit ratios as reasons for these concerns. Although implementation of specialized technology is not specifically mentioned as one of these concerns, lack of training, support and funds certainly influences the placement of this equipment into classrooms.

In the classroom, children with disabilities require modification of the typical school routine, program, or practices in order for them to have maximum opportunity for successful development. The literature reveals that in order for an integrated placement to be successful, the teacher will have to make physical and cognitive adaptations to the already existing program (Bailey & Wolery, 1984). The teacher must make provisions for multi-sensory learning and experiences. The student's individual program must take into account their strengths and weaknesses as they relate to the curriculum. Also, the teacher must have adequate preparation and resource information in order to deliver a program addressing the needs of an exceptional child. If possible,

the teacher should have access to a professional trained in the education of exceptional children and the school should have a support system established that the teacher would be able to access (Bailey & Wolery, 1984).

Effective integration is dependent upon the severity of the disability, the age of the child, the developmental level of the child, the goals of the program and the training of the teacher (Bailey & Wolery, 1984). Based on the diversity of factors involved in the planning of an educational program, research must continue to address the issues of integration in order for educators to provide the best programming for students with a handicapping condition.

Whether mainstreaming results in positive or negative outcomes for children with or without disabilities depends on how teachers structure classroom learning (Johnson & Johnson, 1989). How teachers structures their classrooms directly reflects the training and experiences that they have had and the philosophies that the school jurisdictions operate under. Institutions of higher education, have the opportunity to lead the way in the preparation of a regular education system designed to meet the unique needs of all students. These institutes are in a position to teach prospective teachers how to facilitate the merger of general education and special education (Stainback & Stainback, 1989). In the true sense of regular education, teachers must actively become involved in the selection of specialized

technical equipment. The presence of an assessment tool to assist them in the process would facilitate this process. The development of an assessment tool for specialized technical equipment begins with the identification of student characteristics.

Characteristics of Students with Visual Impairments

Student characteristics are an important part of the evaluation process in the selection of technical equipment. A review of the literature revealed student characteristics that are important include: (a) the age of students; (b) disability or disabilities of students; (c) abilities of students; and (d) specialized skills that students may or may not have.

Age of Student. Age of the student appeared on lists generated by such experts as Bishop (1986) and Koenig and Holbrook (1989), as educational planning for students with visual impairments were discussed. Spungin (1985) identified characteristics of potential users of technology designed for students with a vision loss. Age-related problems such as lack of fine motor development, as seen with pre-schoolers or deteriorating fine motor control indicative of aging persons, was included as one of the important characteristics. The remaining characteristics that Spungin outlined appear in Table 1. Many of these characteristics are applicable to sections that follow and for this reason have been included.

Insert Table 1 about here

Disability of Student. Children and youth with visual handicaps may have other, less severe, special educational needs which have an impact on decisions regarding their school placement and on the formulation of individualized education programs specific to the implementation and use of technical equipment (Scholl, 1986). The range and combination of these impairments is vast and it is unlikely that any two students will have exactly the same disabilities. Scholl (1986) listed examples of possible combinations of visual loss with auditory impairments, mental retardation, learning disability, and motor impairments.

Bishop (1986) identified motor development as one of the characteristics from his list of student disabilities to be considered. Motor limitation could complicate the use of technology or the access to information. Gross motor involvement affecting the use of technology includes motor control and stability of the arms, trunk and head. Hand control determines capabilities to perform necessary fine motor skills such as flipping power switches to intricate keyboarding skills.

According to Lowenfeld (cited in Scholl, 1986) the way in which an individual behaves or learns to adjust to visual

impairment is dependent on several subjective variables: (a) personality; (b) additional handicaps; (c) degree of vision; (d) age and type of onset; and (e) present condition.

Abilities of Students. Children and youth with visual impairments may have abilities or attributes, such as the ability to read, which would assist them in the acquisition of skills specific to the use of specialized technical equipment. Koenig and Holbrook (1989; 1991), described a two-phase process to be used by a multidisciplinary team in making decisions on the reading medium for students with visual impairments. This process took into consideration individual characteristics of students which were relevant to the selection of primary reading medium. Phase one was a diagnostic teaching phase which collected information on a student's use of sensory information during the reading readiness stage which guided the team to decide on the introduction of primary reading medium. The second phase occurred over several years and involved continued evaluation and adjustment to the reading medium. Phase two assured that students had access to the combination of media necessary to be successful in academic and vocational settings. Based on information from their research, Koenig and Holbrook (1992) developed a checklist which included the following student characteristics for consideration: (a) cause and stability of the visual impairment; (b) visual functioning (stable or deteriorating); (c) the academic

ability of the student; (d) the ability to handwrite or print; and (e) the comprehension and rate of reading.

The ability to follow written or auditory direction is a student ability that Bishop (1986) reported as having an impact on decisions which influenced the implementation of technical equipment into classrooms which service students with visual impairments. For example, if success with a piece of specialized technical equipment was contingent on the ability of the student to follow a series of directions the teacher would want to know how complicated the directions would be and if the student had the ability to learn how to use the equipment.

Learning to understand synthetic speech and processing the information was contingent on good listening skills (Brunken, 1984). For example, if the student received a piece of equipment that offered instruction through voice synthesis, following auditory direction was then directly influenced by the students ability to listen.

Specialized skills. Children or youth with visual impairments may or may not have specialized skills that are necessary to facilitate the use of specialized technical equipment. Specialized skills that were either a prerequisite for the use of the equipment or that the student may need to develop because of their visual impairment included: (a) previous experience in the use of technology; (b) previous training; (c) competence in braille

reading and/or writing; and (d) previous experience and training specific to the use of the computer (Koenig and Holbrook, 1991). Brunkin (1984), a computer teacher and media specialist at the Nebraska School for Visually Handicapped, stated that progress and success in the computer technology program was affected by the following criteria: (a) knowledge of the keyboard; (b) development of listening skills; (c) ability to follow directions; (d) level of cognitive development; and (e) level of literacy in print and braille.

Cronin (1992), discussed uses of computers by students who use braille. He identified prerequisite skills for the use of the computer that would be taught by a professional trained in educating students with visual loss. Some of these prerequisite skills include: (a) mastery of the Qwerty keyboard; (b) knowledge and understanding of a print readout; and (c) training in the organization and coordination of work. The remaining prerequisite skills have been outlined in Table 2.

Insert Table 2 about here

Specialized technical equipment is selected for use in the classroom primarily for use by the student with a visual impairment. It is therefore important that characteristics of the student be considered as part of the assessment

process. In addition to student characteristics, characteristics of the educational classroom program must also be taken into consideration. These considerations are discussed in the following section.

Characteristics of Programs which include Students with Visual Impairments

Characteristics of programs which include students with visual impairments that can have an impact on the selection of technology include: (a) accessing the curricula; (b) teacher characteristics; and (c) the instructional methods utilized.

Accessing the Curricula. Students with visual impairments are entitled to the same instruction in reading, mathematics, social studies, science and language arts, and so on, that sighted peers receive. In addition, they require the chronological-age and developmentally appropriate instruction in the skill areas required to meet their needs as individuals with a vision loss (Curry & Hatlin, 1988). If teachers and students have access to specialized technical equipment, the student is more likely to access most of the information used by the teacher for instruction. A Committee to Develop Gidelines for Literacy was established in June of 1990 and consisted of experts in the field of education for students with visual impairments. Their primary objective was to develop guidelines to assist teachers with the selection of a primary learning media. (Committee for

Develop Guidelines for Literacy, 1990). This objective was established because research showed that a major concern for educators of students with visual impairments is the appalling numbers of these children who could be described as functionally illiterate. The Committee identified inadequate opportunities for learning, based on inappropriate selection of media, as one of the reasons attributed for the lack of skill development. The report examined skill development within a target population that was defined as, children with moderate to severe vision loss for whom braille or a combination of braille and print might be the appropriate learning media and students with low vision who have deteriorating disorders that may lead to severe visual loss or total blindness. It was suggested that students within this target population can only have equal access to education if they have equal access to information. An example of one of the recommendations was:

> "appropriately applied technology will enhance braille and/or print literacy skills if the devices provide quantities of well-transcribed braille and high-quality print displays. Audio presentation alone will not allow for details of grammar, spelling and format" (p. 66).

The student with a visual handicap must access information from curricula that is presented largely through a visual media. The most advantageous situation for the student, based on the recommendations of the Committee, would be to use equipment that offers choices (braille, 12 point print, 18 point print, or voice) in the input and

output of information.

Teacher characteristics. Parker, Buckley, Truesdell, Riggio, Collins, and Boardman (1990) identified teacher characteristics that was based on a survey circulated among 120 teachers and habilitative specialists. The respondents reported problems in all areas covered by the survey: (a) knowledge of electronic mobility aids and communication devices; (b) the availability, maintenance, and funding of devices; and (c) adequate information about devices. The teachers interviewed reported that in order to overcome these perceived difficulties they needed to have access to assessment information which matched students and assistive technology. In addition, they requested training in the use of assistive technology, more information about the technology, and availability of technicians to repair and maintain the devices.

Teacher characteristics relevant to the placement of technical equipment into their classrooms, therefore, included the training and experience of the teacher, and the assistance (consultant or teacher assistant) in place. Curry and Hatlen (1988) stressed that the amount of specialist teacher time available impacts on the success of the program. A specialist teacher facilitates acquisition of specialized skills which assist the student to function independently. For example, a specialist teacher of students with visual impairments might teach skills in typing, note-

taking, and specialized computer skills and by the time the student is in high school may only be involved in the acquisition of books and reading materials required by the regular classroom teachers.

Instructional methods. There are many methods or strategies teachers can employ to promote learning by their students. The selection of method depends upon the particular situation but there are also other important factors that can influence what strategy will be chosen. These factors include: (a) setting in which instruction will take place; (b) the specific task; (c) the type of learning expected; and (d) the desired degree of involvement with other learners (Ward, 1986). Stainback et al. (1989) define instructional methods to be the basic instructional processes, such as the development of behavioral objectives, curricular-based assessment procedures, task analysis, the arrangement of antecedents and consequences, and/or open education/discovery methods.

Most teachers agree that the instructional strategies they design for any given instructional session incorporate elements of telling, leading, showing, probing, and verifying (Ward, 1986). These teachers recognize that students will learn when conditions are arranged that will increase the probability of learning.

Spungin (1985) reported on specific performance levels of equipment in different environments and activities that a

student may become involved. Specialized technical equipment can facilitate choices for the teacher specific to the selection of instructional methods. For example, if a student in the classroom is one who uses braille to take class notes the teacher may not use lecture as a primary instructional strategy because of the inability of the student to keep up or the noise occurring because the student is note taking with the Perkins brailler. A braille note taker may facilitate the taking of braille notes quickly and quietly thus leaving lecture, possibly, as an appropriate choice.

Mangold and Roessing (1982) discussed appropriate classroom modifications and optimum classroom conditions necessary to enhance learning. Specialized technical equipment must be considered when the teacher is in the process of selecting demonstrations, questions and probe, guided discussion and discovery and peer tutoring as instructional methods.

Characteristics of specialized technical equipment that need to be considered in the selection of this equipment are discussed in the following section.

Characteristics of Technical Equipment

To facilitate the accumulation of literature specific to technical equipment for use by students with visual impairments, four sources of information were used: Canadian National Institute for the Blind (CNIB) technical resource

center, Journal of Visual Impairment and Blindness (JVIB), Northcott (1990), and research articles. Information from these sources revealed technical characteristics within the following categories: (a) general technical characteristics; (b) input functions; (c) output functions; and (d) voice synthesis.

General technical characteristics. Goodrich (1984) discussed microcomputer applications for individuals with visual impairments. A portion of his discussion included a list of evaluation criteria for voice synthesis, refreshable braille devices, hardcopy braille, large-print computers and optical aids. These criteria were not directed toward specific pieces of technical equipment but rather were more generic in that he looked at evaluating from a functional perspective. Evaluation criteria in each of the above categories are listed in Table 3.

Insert Table 3 about here

Table 3 reveals cost of technical equipment within two of five categories that were listed. Spungin (1985) reported that income or other funds available is an important consideration in the purchase of equipment for students. Morrissette (1984) evaluated large print computers and also included selling price of the equipment as an important feature for students to consider.

Parette, VanBiervliet and Holbrook (1990) identified technological needs of persons with disabilities in Arkansas. They conducted an extensive survey specific to life functioning, spending practices, credit options for purchasing devices, funding support systems, travel practices, need for further information, and satisfaction with services and devices. Information acquired from this survey was used to establish the Arkansas Technology Access Program, and is the only report at this time to have addressed these issues. One of the important findings of this study related to the availability of technical equipment as loaners to students to allow them to the opportunity to use the equipment prior to purchase. The study found that persons with disabilities were not involved in the selection of their technological devices and relied on the judgments of the professionals involved with the educational program.

Uslan (1992) discussed two major obstacles individuals with visual impairments face when considering the purchase of assistive technology: (a) cost and lack of information about technology; and (b) financial assistance programs. These individuals could also face barriers specific to the details of the warranty, extended warranty, technical support accessed through an 800 number, cost of shipping if there is one, and proximity of the manufacturer to the consumer. Morrissette (1984) in his evaluation of large

print computers lists service location as an important evaluation criteria.

Ruconich (1984), although very general in her discussion regarding characteristics that were worth considering when choosing technical equipment, included cost-benefit ratio, portability and user speed.

According to Scadden (1984), manufacturers and/or distributors can assist the promotion of improved quality of life for individuals with visual impairments in the age of improving technologies by offering rental agreements, lease-purchase arrangements, low interest loans, purchase subsidies, and clearly indicating what the consumer will receive with their purchase. The industry must be encouraged to become involved in the design and testing of demonstration projects and bear in mind that the future may offer other choices for the consumer and therefore create a possibility of expansion. Companies must create software in numerous areas which will facilitate the interactive use of computers by individuals with a visual loss.

Wurzbach (1988) suggested that one key aspect to successful reading instruction is the creation of comfortable, low-stress but stimulating environments. It is important to recognize the characteristics of these environments in order to facilitate the use of specialized technical equipment in them. Programs should provide students with comfortable places in which to read, and

places with carpets or beanbag chairs or pillows or a rocking chair in which to sit. Individual spaces as well as group spaces should be available. Mangold and Roessing (1982) added that the classroom should contain appropriate modifications and optimum conditions for near point work: (a) an additional light source; and (b) increased or decreased height of work area. In order to incorporate technical equipment into these environments, consideration must be given to the size of the equipment, ease with which it is stored, durability and necessary modifications (e.g., extra table, shelves, special chair, access to a power source, specialized desk and additional light source). The length of the power cord must be able to accommodate a variety of placements throughout the room, as well as the ability of the equipment to operate from a battery source, if the student is to access these specialized environments and still benefit from the use of the equipment.

Mack, Koenig, and Ashcroft (1990) discussed the importance of the acquisition of basic competencies in the use of microcomputers and related access technology for teachers of students with visual impairments. In the event that teachers are not trained in the use of technical equipment, an important characteristic of the equipment becomes the level of training available from manufacturers and/or distributors. Mack et al. (1990) stated that in order for skills to be acquired by teachers they must have

equipment, resources, and positive attitudes that will foster computer literacy in students who are blind or visually impaired. Resources for teachers, supplied by the manufacturers, could include teaching suggestions specific to the how the equipment can be used to acquire skills taught in the classroom. For example: if the teacher is teaching "brainstorming" to generate ideas for story writing, she may write theme words on the board for the students to read during the activity. The student who is blind could use a refreshable braille display to read these words if the teacher or teacher assistant has input them into a computer which has been interfaced to the braille display. Teachers who are not familiar with the function(s) of specialized equipment will need this kind of information if they are to utilize the product. Curry and Hatlen (1988) stated that there must be available teaching materials in areas of braille instruction, orientation and mobility, and concept development. These teaching materials are specific to those students with a visual impairment and are therefore unique.

The report of the Committee to Develop Guidelines for Literacy (1991) outlined several principles related to their task of determining recommendations for the selection of appropriate media for students with a visual impairment. The selection of appropriate media takes into consideration choice of specialized technical equipment. The appropriate

choice of technical equipment can facilitate independence for the student with a visual disability through the management of classroom materials. The document suggested that expectations held for students with a visual handicap should be the same as those for students with normal sight. Examples of reduced expectations from students with a visual impairment may have included shortened classroom or homework assignments and/or accepting work of lesser quality. When the classroom teacher had not reduced expectations of the student with a visual impairment, difficulty with classroom assignments suggested a potential change of medium, or equipment rather than acceptance of poorer quality of work. Teacher expectations should be consistent in all areas of classroom participation. Students with a visual impairment should be expected to maintain technical equipment through cleaning, storage, assembly and lubrication.

Corn and Ryser (1989) completed a study related to issues surrounding the use of large type and optical devices by children with low vision who use print as their primary medium. One of the major issues that their study addressed was the appropriate use of optical devices to facilitate the least restrictive educational environment for the student. Information for this study was collected from 109 teachers, who completed questionnaires on approximately 400 students on topics such as reading speed, reading achievement, fatigue and reasons for the nonuse of prescribed optical

devices. Based on the results of the study, the authors concluded that optical devices offer certain advantages to low vision students for functioning in the sighted world and therefore the use of optical devices should be viewed as the least restrictive approach to gain access to all regular-print materials for near and distance tasks.

Rosenbloom (1992), discussed low vision rehabilitation as more than prescribing low vision devices. He stated that it involves an accurate diagnosis and prognosis of the visual condition, an analysis of a patient's physiological system in relation to his or her lifestyle needs and expectations, instruction and often adaptive training addressing the visual loss in an educational placement, communication with other professionals, and referral to appropriate support services. Instruction and adaptive training in educational programs must establish standards, including alterations to the environment, to enhance the following areas: (a) glare; (b) proper illumination; (c) independence; (d) classroom learning environment; and (e) mainstreaming which includes equal access to age appropriate curriculum materials.

Characteristics specific to input functions of specialized technical equipment are discussed in the following sections.

Input characteristics

Northcott (1990) categorized equipment according to function. Characteristics of technical equipment are based on input and output functions within categories that Northcott outlined. Input functions include: (a) large print computer and software; and (b) braille software.

Large print software and computers. Large print or large type, usually refers to letters which are 14 to 30 points high. Large print can be produced by photo enlarging standard type, resetting standard type in large sizes, or typing on a large-type typewriter (Todd, 1986). Many students use large print in combination with other aids, such as tapes, magnifiers, and/or closed circuit television systems. Large print software for microcomputers is also available. Morrissette (1984), as previously mentioned, evaluated large print computers and his evaluation criteria has been included in the Table 4. Evaluation characteristics

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Insert Table 4 about here

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specific to input function of the large-print computers included: (a) keyboard configurations; (b) memory configuration; (c) program and data storage; (d) hardware and/or software included; (e) options available, which could include choice of font or the ability to do graphics; and (f) documentation.

Goodrich (1984) included sufficient magnification and field size as two important evaluation criteria in his evaluation of technical equipment (see Table 3).

Braille software. Braille software facilitates the use of the computer for the student who uses braille. Carter (1992) evaluated two braille note taking devices. The two pieces of equipment that he evaluated were the Braille 'n Speak and the BrailleMate. His evaluation compared these two pieces of equipment by identifying similarities and differences across a variety of categories. Characteristics evaluated by the author included: (a) managing a file; (b) functions of the cursor; and (c) ease of use. The results of his evaluation are included in Table 5.

Insert Table 5 about here

Hendel (1992), a computer instructor to people who are blind, many of them Spanish speaking, evaluated the Braille 'n Speak which has been adapted for Spanish. He considered conversion of language and documentation that accompanies the equipment, as major attributes in his evaluation.

Goodrich (1984) included the difficulty with conversions between grade 1, grade 2, 3, and computer braille, as well as the display available as important evaluation characteristics in his evaluation of technical equipment (see Table 3).

Characteristics specific to output functions of specialized technical equipment are discussed in the following sections.

Output characteristics

Output devices include: (a) computer screens; (b) refreshable braille display; (c) braille printers; and (d) voice synthesis. Bishop (1986) reported that output material from a specialized piece of technology, whether large print, speech synthesis, or braille (refreshable or hardcopy), must be properly formatted with minimal mistakes and high quality reading and/or listening.

Computer screens. Children who have difficulty in perceiving objects clearly come to believe they can never recognize complicated objects of images no matter how hard they try and eventually lose their desire to look and observe (Muranaka, Furuta, Aoki, & Gohke, 1985). The common closed-circuit system is so effective in overcoming lens limitations for persons with visual impairment that it is considered an excellent reading and writing aid (Fay, cited in Muranak et al., 1985).

The authors research revealed that low vision learners needed to be motivated to look. This motivation could be achieved through the introduction of colour to the screen, clarity and magnification of the image produced on the screen, and the reduction of glare. In summary, the image needs to give the student pleasure in seeing things clearly.

Refreshable braille display. The braille on the display is a mirror of what the sighted person would read on the screen and because it is continuously changing is referred to as refreshable braille. Refreshable and hardcopy braille devices can be divided into the following sub-categories: (a) braille printers; (b) braille note takers; (c) translating programs; (d) braille display; and (e) scanners (Northcott, 1990). Professionals in the field of educating students with visual impairments share a concern that braille readers are becoming illiterate because of the challenges that braille presents (Rex, 1989). Challenges that braille presents includes: (a) cost; (b) the difficulty of reproduction/ not readily available; (c) the complex braille code; (d) bulk of storage; and (e) lack of knowledge or competence of the teacher. For these reasons, perhaps the most exciting and rapidly expanding area of technology is the utilization of microcomputers by braille users. Huebner (1989) provided an exhaustive list of uses of braille, which indicated that braille readers and writers use braille the same way sighted students use print. Through the use of appropriate software, hardware, and peripherals, the person who is blind can use word processing programs to enter the data through the regular keyboard, or with an alternate device (Todd, 1986). Depending on the assistive technology being used, braille files can be retrieved and read on a braille display, and/or printed as a braille hardcopy.

Braille printers. Dotson (1991) sold computer products and is a braille user. He wrote an article in the periodical "Tactic", discussing the results of an evaluation of two braille printers. Criteria that he was primarily interested in included speed of the printer, interfacing capabilities, and sound level.

Kendrick (1991) has written an informative critique of the Braille Blazer embosser. Her evaluation took into account portability, price, interfacing capabilities, production of text or graphics on paper ranging from 20-pound 'print' to 100-pound 'braille' paper, and speed of production. She discussed drawbacks of the Blazer and information specific to the purchase of one.

Leventhal and Uslan (1992), staff of the American Foundation for the Blind (AFB) Technical Evaluations Unit, compared two electronic braille note taking devices. For the purpose of this evaluation they reviewed the documentation and compared layout and feel of each device's keyboard. In addition, each device was evaluated on accessories, speech quality, braille display, command structure, printing, memory and file storage, utilities and technical support.

Voice Synthesis. According to Northcott (1990), speech systems and software fell into five sub-categories: (a) software and synthesizer; (b) software; (c) software and extra keyboard; (d) synthesizer; and (e) external.

There are two classes of voice synthesizers,

inexpensive and expensive (Goodrich, 1984). The inexpensive voice synthesizers are characterized by low-quality (but intelligible) pronunciation, limited exception dictionaries (the number of words that were not pronounced according to the general rules of English), limited review capabilities, and relatively slow speaking rates. Expensive voice synthesizers are characterized by high-quality pronunciation, large exception dictionaries, relatively fast speaking rates, and overall good review and shut-up capabilities. The review and shut-up capabilities allow the user to review text at any point and/or to shut off the speech. Goodrich (1984) included review and shut-up features as important evaluation criteria for technical equipment in his evaluation of technical equipment (see Table 3).

Slivoski (1991), a secretary with a visual impairment working for the IRS in New York City, wrote about the use of a speech package that allowed her to do her job. The article was an overview of this speech package which included: (a) set-up capabilities; (b) options; (c) available in the screen set-up submenu; (d) keyboard options; and (e) features and documentation available.

The literature indicates that there are significant characteristics of students with visual impairments, the programs that they are part of, and the equipment that they might work with. It is important, therefore, to ensure that all of these characteristics be considered in the

development of as assessment tool to evaluate technical equipment. This study has incorporated these characteristics into the development of an assessment tool for technical equipment. The development of this tool is described in Chapter 3. Chapter 4 reports and discusses the results of the application of this tool.

CHAPTER 3

Method

The purpose of this study was twofold: (a) to develop an assessment tool, taking into account student characteristics, program characteristics and equipment characteristics; and (b) to use this assessment tool to evaluate technical equipment for the blind and visually impairment. For this reason, the method section has been divided into two sections. The first section, the development of the tool, includes: (a) review of the literature; (b) matrix of characteristics; (c) the assessment tool; and (d) procedure to establish validity. The second section, using the tool to evaluate equipment, includes: (a) participants; (b) technology to be reviewed; (c) data analysis; and (d) procedure to establish reliability.

Development of the Tool

The evaluation tool was developed to fulfil a need of offering accountability in the placement of specialized technical equipment into classrooms that have students with visual impairments. In order to facilitate this process an extensive review of the literature was conducted.

Review of the literature. This study began with an extensive review of the literature. Sources for this

information included the University of Alberta library, and the CNIB Technical Resource Center. In addition, information was accessed from the library of Educational Consultants for the Sensory Impaired, personal library and an interview with a representative from one of the manufacturers which participated in this study. This interview took place because the researcher attended a course, offered by the manufacturer, during the time information was accumulated for the study. No other attempts were made to interview other manufacturers.

The literature reviewed was primarily specific to the education of students with visual impairments. However, to ensure that all relevant issues were addressed, literature reporting on general integration issues and evaluations specific to technical equipment were also accessed.

During the review of the literature, the researcher was looking for reported attributes that have been taken into consideration when technical equipment was evaluated. These attributes were accumulated on a matrix, developed for this research, and referred to as characteristics.

Matrix of characteristics. The literature reported findings, specific to the evaluation of technical equipment, primarily from one of three different perspectives: (a) student characteristics; (b) program characteristics; and (c) technical characteristics. Authors such as, Bishop, Koenig and Holbrook, and Spungin (1986, 1991, 1985),

reported student characteristics that they described as necessary when consideration was being made of the use of technical equipment for students with visual impairments. Secondly, The Committee to Develop Guidelines for Literacy (1990), Curry and Hatlin (1988), and Mangold and Roessing (1982) were examples of authors that addressed important characteristics relevant to the educational programs or classrooms that have students with visual impairments who will be using technical equipment. Generally, these authors reported that teachers, who teach students with visual impairments, needed to be aware of these program characteristics. Finally, authors such as Carter (1992), Dotson (1991), and Kendrick (1991) reported evaluations of specialized technical equipment. These evaluations focused primarily on the characteristics, specific to the function, of the equipment.

The matrix (see Appendix 1) was divided into three columns with the following three headings: (a) student characteristics; (b) program characteristics; and (c) technical characteristics. As each characteristic was discovered in the literature it was listed in the appropriate column.

Characteristics within each column were grouped in subcategories. Student characteristic subgroups included: (a) age of students; (b) disabilities of students; (c) abilities of students; and (d) specialized skills. Program

characteristic subgroups included: (a) accessing the curricula (considers grade levels, subject areas and the ability of the equipment to accommodate the production of materials into the appropriate medium for student use); (b) teacher characteristics (considers the degree of involvement between the teacher and the student using the equipment as well as training required, the involvement of a consultant with training, support or assessment, and the involvement of a teacher-aide): and (e) instructional methods (considers whether the student can use the equipment in a variety of instructional environments). Technical characteristic subgroups included: (a) general technical characteristics (the included areas of cost, loaner available, payment plan and warranties, technical support, physical management of the equipment within a classroom or educational environment such as the ability to be carried, durability, special equipment necessary such as a chair, desk, shelves, and power source, training available, expansion capabilities, interfacing capabilities, the ability of the equipment to facilitate independence with the exchange of materials, placing the student in the least restrictive environment, and facilitating equal access to grade appropriate materials); (b) input characteristics (large print software and computers and braille software); and (c) output characteristics (computer screen, refreshable braille display, braille printers, and voice synthesizers). This

process of organizing the information ensured that relevant characteristics were neither missed nor repeated. The characteristics accumulated on the matrix are included in Appendix 1.

The assessment tool. Each characteristic identified on the matrix was worded into an evaluation question see Appendix 2). The questions were worded so that they could be answered with 'yes', 'no' or 'not applicable' responses. These choices were headings of three columns to the left of the question. Responses were made by making a mark in the appropriate column. Questions that were structured to include more than one part (i.e., questions identified with an a, b, & c), required a separate response for each part. The questions were worded so that a 'yes' response indicated versatility of the equipment being considered.

There were 15 questions in the student characteristic section of this assessment tool. Several of these questions had more than one part and therefore there was a possibility of 46 'yes' responses when all questions were answered. The program characteristics section had 10 questions with a possibility of 27 'yes' responses. The technical characteristics had 59 questions and a total of 69 possible 'yes' responses.

At the end of each of the three sections space was allocated for comment(s). As the evaluation tool was being used; concerns, questions or reference to special

circumstance of a particular situation could be recorded in the comment space. For example, if the evaluation was being done on a specific piece of equipment and the assessor felt that additional criteria were necessary under one of the categories, this criteria could be recorded in the comment space. The evaluation tool that was developed has been included in Appendix 2.

This tool was developed in the hopes that it would offer accountability to those professionals responsible for the placement of technical equipment with students who have visual impairments. In order to ensure that this tool is appropriate for this use validity for the tool was established.

Procedure to establish validity. Tawney and Gast (1984) reported several definitions for validity including Websters roughly paraphrased definition of, legal authority to act (Webster's New World Dictionary, 1984). The definition most closely fitting this research project is best described as "appropriate to the end in view" (Tawney and Gast, 1984, p. 89). Therefore, in order to establish the validity of this assessment tool, it must be shown that the process used in the development of the tool, and the use of the tool as an evaluation instrument, appropriately fulfils this definition. Validity was established in areas of content validity and social validity.

Content validity. Content validity is defined as the

assessment of whether the substance of the items taps the entity that is being measured (Corcoran & Fischer, 1987). There are two approaches to content validity, face validity and logical content validity. Face validity was established when the content of information available was represented by the evaluation questions. Information available included descriptions of characteristics of students with visual impairments in a classroom, program characteristics of classrooms where these students are being educated, and characteristics of specialized technical equipment. The assessment tool was developed by establishing a matrix with the headings, student characteristics, program characteristics and technical characteristics. Criteria which addressed the evaluation of specialized technical equipment were drawn from the literature and listed under the appropriate headings. The matrix facilitated an exhaustive list of criteria and ensured that no criteria items were repeated or eliminated. Each criteria item from the matrix was represented by an evaluation question. The process by which this assessment tool was constructed was valid because it was based on characteristics of students, program and technical equipment and therefore the tool would be suitable for assisting in the selection of appropriate specialized technical equipment for children with visual impairments.

Logical content validity was established throughout the

development of the assessment tool when the matrix and evaluation questions were circulated among a panel of individuals. This panel consisted of, two professionals working as consultants for the visually impaired, two classroom teachers that have students with visual impairments in their classroom (grade one and six), two teacher assistants that work with students with visual impairments, and one university professor whose expertise is the development of assessment instruments. These individuals were asked to respond to the accuracy of the characteristics identified, the appropriateness of these characteristics, and, specific to their own experiences, were there any characteristics that had not been mentioned that should have been. They were also asked if they felt the tool appropriately fulfilled the objective of its development. The objective of the tool was to develop an instrument that could be used to assist educators in identifying appropriate pieces for specialized technical equipment for students with visual impairments.

Social validity. Wolf's study (cited in Tawney and Gast, 1984) suggested that there are three levels of social validation: (a) goals; (b) procedures; and (c) effects. The goal of this research was to create a tool that educators could use to facilitate the appropriate placement of specialized technical equipment. The literature search, the development of the matrix which facilitated the development

of the tool, and the sampling of the questions with the panel, ensured that the assessment tool appropriately reflected student, program, and technical characteristics. The students who are visually impaired will directly benefit from the development of this assessment tool because the use of this tool will facilitate appropriate placement of specialized technical equipment. One can assume that the placement of appropriate equipment can only enhance these students' quality of education rather than impede or maintain it.

Following the establishment of the validity of the assessment tool, it was used to evaluate technical equipment.

Using the Tool to Evaluate Technical Equipment

Included in this section are: (a) participants; (b) technology to be reviewed; (c) data analysis; and (d) procedure to establish reliability.

Participants. A participant in this study was defined as manufacturers and/or distributors who forwarded information on their products. Twenty-eight manufacturers and/or distributors of technology, for use by students with visual impairments, were contacted by letter (see Appendix 3). The letter requested information and pricing information specific to their products. The names of these contacts were identified through four sources:

1. Northcotts inventory of equipment (1990);

2. CNIB Technical Resource Department in Edmonton, Alberta;
3. Advertisements in the Journal of Visual Impairment and Blindness;
4. Other literature.

Potential manufacturers and/or distributors and their addresses are listed in Appendix 4. Information received from these manufacturers and/or distributors is discussed in the following section.

Technology to be Reviewed. Information received from the manufacturers and/or distributors varied from company to company. Variations included the following: (a) extensive catalogue listing all products available and includes some written information about product; (b) pictures of selected equipment accompanied with written information; (c) price list of all products; (d) price list on selected products; (e) no catalogue but flyers marketing one, two or three of most recent technology; (f) flyers accompanying catalogue; and little or no written information about catalogue products.

Based on Northcotts inventory (1990) categories were established for the equipment according to its function. A matrix was developed with the following headings: (a) company; (b) braille; (c) voice; (d) large print; and (e) other (see Appendix 5). As the information from the manufacturers and/or distributors arrived, the company name

was written on the matrix and all braille products were listed in the braille column, voice products in the voice column and large print products in the large print column. In some cases, it was difficult to determine which category the equipment should be placed into because they either offered several functions, for example braille and voice, or they didn't seem to fit into braille, voice or large print. For example, one company was marketing an IBM laptop computer. The equipment was subjectively put into the category that the equipment was primarily marketed for or placed into the column with the heading 'other'.

Some products were available from several manufacturers and/or distributors and in these cases the products were listed under the manufacturer and/or distributor that sent their information first. For example, the braille product 'Braille 'n Speak' was available from Blazie Engineering, Telesensory Inc., and Frontier Computing. Product information was received from Frontier Computing first. For this reason Braille 'n Speak was included with products from Frontier Computing and therefore evaluated according to the information that Frontier sent. The matrix, containing the complete list of products, has been included in Appendix 5.

Date Analysis. Data for this research was collected on data sheets listing the manufacturers and their products in a column on the left hand side of the paper (see Appendix 6). The researcher used the matrix to list the manufacturer

and/or distributor onto the data sheets. The equipment was listed underneath the manufacturer and/or distributor that it was representing during this study. Braille equipment and their respective manufacturers and/or distributors were together on the data sheets. Large print equipment and their respective manufacturers and/or distributors were listed together on a second set of data sheets and voice equipment and their respective manufacturers and/or distributors were listed together on a final set of data sheets. Equipment listed in the 'other' column was not included in the evaluation process because equipment represented in this column was generally not equipment designed for individuals with visual impairments. For the purposes of this study, equipment available as versions or upgrades (for example: Romeo 20 cell or 40 cell), were evaluated as one piece of equipment. Versions or upgrades are listed on the matrix listing products available from the manufacturer and/or distributor (see Appendix 5). The version or upgrade used in the evaluation was chosen randomly and a complete list of equipment evaluated has been included in Appendix 6.

Numbers from the corresponding questions on the assessment tool were listed at the top of each column moving across the page. Student characteristic question numbers were listed on one page, program characteristic question numbers were listed on a second page, and technical characteristic question numbers were listed over three

separate pages (Questions 1-11 grouped general technical characteristics on one page, 12- 17 grouped input characteristics on a second page, and 18-30 grouped output characteristics on the final page). In total five data sheets represented all of the assessment questions.

During the evaluation, the researcher went through all of the braille equipment first, the large print equipment second and the voice equipment third. Starting at the top of the braille equipment list, the researcher pulled the information sent from the company listed on the top of the data sheet. This information was read and was continually referred to as the questions were applied to each piece of equipment. As each question was asked, the researcher referred to the documentation and responded accordingly. A dot on the data sheet represented a 'yes' response, an x represented a 'no' response and an N/A represented a response that the answer was not known or the question did not apply to the equipment being evaluated.

For the purposes of this study, personal experiences with the use of equipment were taken into consideration. For example: the researcher has worked with the Braille 'n Speak and knew from experience which age groups used this equipment. These experiences were discussed with the rater's during the training for reliability.

Procedure to establish reliability. "In the field of test construction and evaluation, 'to be reliable' means

that a test will yield the same results if administered more than one time" (Tawney & Gast, 1984, p. 88). Reliability may be established if more than one person in the field of educating children with visual impairments, can use this assessment tool to evaluate specialized technical equipment and obtain similar results. Reliability of this assessment tool was verified through the following procedures.

The equipment evaluated in this study were listed under one of three categories (braille, large print, or voice). During the evaluation of each piece of equipment the total number of 'yes' responses were recorded in a total column on the data sheet as each subcategory was completed. 'Yes' totals from each subcategory for each piece of equipment were tabulated on a summary table, as well as total overall 'yes' responses. When all pieces of equipment in the braille category were evaluated, the total 'yes' responses were ordered from the highest number to the lowest number. At the completion of these lists a figure representing approximately twenty percent of the equipment was calculated. Twenty percent of braille equipment was represented by eight pieces of equipment. This procedure was repeated for the large print and voice equipment and as a result, large print equipment was represented by four pieces of equipment, and voice equipment was represented by five pieces of equipment. To choose those pieces of equipment that would be used to check reliability the braille

equipment was numbered 1-8 down the ordered list. In this way the selection was random and represented high, medium and low responses proportionately. This process was repeated for the large print and voice equipment lists.

Those pieces of equipment selected for the reliability check were then listed on data sheets and set aside. Each rater would assess the same pieces of equipment for the reliability test. Those pieces of equipment remaining on the list were used to train two individuals from within the field of educating students with a visual handicap, to use the assessment tool in the same manner that it was used during the original evaluation process. The training of these two individuals required that the researcher go through the assessment tool with each of the remaining pieces of equipment. The researcher read the question out loud and discussed the reasons used in making a response. For example, the researcher answered questions 2.2 through 3.4 from technical characteristics only for the first piece of equipment from a particular manufacturer and/or distributor. The researcher assumed that company policies applied to all pieces of equipment and therefore repeated the responses from the first piece of equipment for all of the other pieces. This training facilitated a transfer of information from the researcher to the rater which offered an element of control to those questions which required subjective interpretation.

Two individuals were chosen to participate as reliability raters who had similar philosophies, background experiences and training as the primary researcher.

Rater #1 and Rater #2 completed the assessment of all pieces of equipment (each rater evaluated the same equipment) on their data sheets. Each data sheet was compared to the original assessment of each piece of equipment. Each question was marked as an agreement or as a disagreement. An agreement was defined as a response or responses which were the same as the researchers response or responses. Those questions that had more than one part had to agree with the researcher on all parts in order to be counted as an agreement. Agreements for each section of the assessment tool were calculated as percentages and the two percentages, percentages from rater #1 and rater #2, were averaged to represent the average percentage of agreements for each category. As well, an overall percentage of agreements were recorded. The overall percentage of agreements was calculated by adding the overall percentages from each rater and dividing by two.

Chapter 4 reports the results of the evaluation of technical equipment using the assessment tool developed in this study. The results of this assessment as well as the results of the reliability test are discussed as they are reported.

Chapter 4 concludes with a discussion on the

limitations of this study, future research and conclusion.

CHAPTER 4

Results and Discussion

PLEASE NOTE

MANUFACTURERS AND/OR DISTRIBUTORS INCLUDED IN THEIR INFORMATION PACKAGES LISTS OF EQUIPMENT THAT WERE ONLY ACCOMPANIED WITH A PRICE. THESE PIECES OF EQUIPMENT HAVE BEEN INCLUDED IN THIS STUDY FOR TWO REASONS. FIRSTLY, THE RESEARCHER INTENTED THIS STUDY TO BE USED FOR MANY PURPOSES ONE OF WHICH WOULD BE TO INCLUDE A COMPREHENSIVE LIST OF EQUIPMENT AVAILABLE. IF THESE PIECES OF EQUIPMENT WERE NOT LISTED THE IMPRESSION LEFT IS THAT THE MANUFACTURERS ONLY OFFER THOSE PRODUCTS INCLUDED IN THE STUDY. SECONDLY, THE INABILITY TO APPLY THE ASSESSMENT TOOL TO PIECES OF EQUIPMENT THAT ARE NOT ACCOMPANIED WITH INFORMATION IS SIGNIFICANT IN THAT MANUFACTURERS AND/OR DISTRIBUTORS ARE NOT ONLY INFORMED OF INFORMATION THAT IS NECESSARY IN ORDER FOR EDUCATORS TO MAKE A DECISION SPECIFIC TO THE PURCHASE OF EQUIPMENT BUT ALSO THE IMPLICATIONS OF THE LACK OF INFORMATION. THE LOW EVALUATION OF EQUIPMENT WHERE ONLY A PRICE WAS AVAILABLE IS INDICATIVE OF THE LACK OF INFORMATION AND NOT THE INADAQUATE FUNCTION OF THE EQUIPMENT. EQUIPMENT INCLUDED IN THIS STUDY WITH ONLY A PRICE AS INFORMATION HAS BEEN LISTED IN APPENDIX 7.

The results of this study are reported and discussed in five sections. These sections include: (a) development of

the tool; (b) application of the tool; (c) limitations; (d) future research; and (e) conclusion. Tool development is further subdivided into two subsections which reports and discusses the development of the tool and the validity of its development. The application of the tool section has been subdivided into four subsections which includes: (a) braille equipment; (b) large print equipment; (c) voice equipment; and (d) reliability.

Development of the Tool

Each of the student, program and technical characteristics listed on the matrix, found in Appendix 1, were worded into an evaluation question. These questions were worded to facilitate a 'yes', 'no' or 'not applicable' response.

Results. The assessment tool was developed in three sections. Section one included questions specific to student characteristics. There were a total of 15 questions in this section. Questions 2.6, 2.7, and 3.4 were the only questions in this section that had one response when answered. Question 2.1 had two responses, questions 2.2, 2.3, 2.4, 2.5, 3.3, 4.1, 4.2, and 4.3 had three responses, question 3.2 had four responses, and question 1 had 5 responses. When all questions had been answered, there were a total of 43 responses.

Section two, of the assessment tool, included questions specific to program characteristics. There were a total of

10 questions in this section. Questions 4.1, 4.2, 5.1, and 5.2 had one response, question 7 had two responses, question 6 had three responses, questions 1 and 3.2 had four responses and question 2 had six responses. When all the questions had been answered, there were a total of 27 responses.

Section three of the assessment tool included questions specific to technical characteristics. This section was subdivided into three subsections. Subsection one included 25 questions about general technical functions, subsection two included 17 questions specific to input functions and subsection three included 17 questions specific to output functions of the equipment. When all questions were answered, subsection one had a total of 40 responses, subsection two had a total of 23 responses, and subsection three had a total of 17 responses.

The results of the validity of this assessment tool are discussed in the following section.

Validity. Validity of the assessment tool developed in this study was established in areas of content validity and social validity. Content validity was established from two approaches, face validity and logical content validity. During the process of establishing validity from these approaches input from a panel of individuals was taken into consideration. Input from this panel included: (a) suggestions for adding more detail to the matrix cells to

ensure that the points were clear; (b) adding additional points to a single cell (for example, in the cell under 'involvement of teacher' of program characteristics, questions 4.3 an 4.4 were added as a result of panel input); (c) suggestions to improve wording of questions (for example, question 4.3 from technical characteristics, was reduced from three possible responses to one, as a result of panel input); (d) suggestions were made specific to characteristics that needed to be addressed and were not; and (e) several questions repeated themselves and were eliminated as a result of panel input.

The panel agreed that the content of the assessment tool appropriately met the objective of the study. They also agreed that the assessment tool was worthwhile and students with visual impairments would benefit as a result of its development. Following the establishment of validity for this assessment tool it was used to evaluate technical equipment.

Application of the Tool

Twenty-eight manufacturers of specialized equipment for students who are blind or visually impaired were contacted for information about the equipment they distribute. Eighteen (64%) of these companies responded by sending product catalogues and/or price list.

The data sheet, which was developed for this research, listed manufacturers and their products in the left-hand

column of the page (see Appendix 6). The first page of the data sheet had the questions for the student characteristics listed across the top of the sheet. Each column represented one question and for those questions which had more than one part the column was subdivided to accommodate the number of spaces needed to respond to all the parts of the question. For example, question 1 of the assessment tool had five parts (a-e), question 1 was represented in column one and column one was divided into five sections. Column two had question 2.1 as the column heading. At the far right side of the data sheet there was a column where total 'yes' responses was recorded. The second page of the data sheet recorded responses for program characteristics and the remaining data sheets recorded responses for the technical characteristics. Following is a discussion of the results of the evaluation of braille equipment.

Braille equipment. Thirty-seven pieces of equipment in the braille category were assessed (see Appendix 6). The data sheet for the braille equipment was used during the evaluation process.

When all the pieces of equipment listed on the data sheet were evaluated, the total number of 'yes' responses in each category (student, program, tech1, tech2 and tech3), were rank ordered from the highest score to the lowest score. Overall 'yes' responses were also rank ordered. The overall total of 'yes' responses was calculated by adding

each of the section 'yes' totals together. For example, MegaDots received 28 'yes' responses in the student characteristics category, 12 in the program characteristics category, 7 in tech1 category, 6 in tech2 category and 1 in tech3 category, the total 'yes' responses for MegaDots is therefore is 54.

From the rank ordered list of 'yes' responses, the top one third rankings of the equipment were coded, '1', the middle one third rankings were coded, '2' and the bottom one third were coded, '3'. The summary of the results was represented by this ranking system because the numbers representing total 'yes' responses, did not represent the equipment appropriately. For example, some pieces of equipment received scores of 0 because of lack of information from the manufacturer. The 0 reflects lack of information and not inadequate function of the equipment. Also a variety of equipment was evaluated, each with its unique function, using the same assessment tool. The ranking system offered an insight into the versatility of the equipment and at the same time facilitated a comparison study. Chapter two discussed several authors opinions of the impact technology will have in the lives of students with visual impairments. Scadden (1984), Lindstrom (1990), Dixon & Mandelbaum (1990), Mack et al.(1990), Luxton (1990), and Rosenbaum (1990) are examples of these authors. The literature established the presence of specialized

technology in integrated placements and reported that as the focus on computer skills became more intense, technical devices and systems would play an increasingly important role in visually impaired persons' lives (Lindstrom, 1990). Choosing the most appropriate piece of equipment for the student is necessary if the use of the equipment is to be maximized. The Carroll Center for the Blind attempted to address this need by offering a technical training program for students and teachers to facilitate the choice of the most appropriate and versatile piece of equipment (Rosenbaum, 1990).

The 'yes' responses for each section of the assessment has been summarized in Table 6. As well, the overall 'yes' responses for each piece of equipment were recorded in the total column.

Insert Table 6 about here

From the total list of products evaluated, approximately one third, nine, of those products were known to the assessor from direct working experience or observation. These products included: (a) Duxbury; (b) Braille 'n Speak; (c) Perkins; (d) Blazer embosser; (e) Optacon; (f) OsCar; (g) Everest DT; (h) BrailleMate; and (i) Navigator. Navigator, BrailleMate, OsCar, and Braille 'n Speak, were ranked in the top one third in the total column

on the summary table.

The top one third of the ranked pieces of equipment included, braille note taking devices (Braille 'n Speak and BrailleMate), software (MegaDots and Hot Dots), and braille printers (Blazer embosser). The Braille 'n Speak was the only piece of equipment ranked in the top one third across all of the categories. The BrailleMate, competitor to the Braille 'n Speak, ranked in the top one third of all the categories except for one. In the Tech2 column, the BrailleMate ranked in the middle one third instead of the top. In a situation where two pieces of equipment are ranked very closely to one another, consultation with a specialist may be worth considering. A testimonial from a teacher in the Alberta Teachers Association report 'Trying to Teach' (1993), which is a reaction to a question on integration, states:

> "Up until now, it seems that we needed highly trained special needs teachers to assess these students and develop individual programs specifically suited to each students' needs. These teachers needed special university training to learn how to do this. Once in the workplace, they also needed low numbers of students under their care due to the great time factor... and so on." (p. 6)

Specialized teachers of students with visual impairments would have training in the use of both pieces of equipment and as a result would facilitate the appropriate selection of equipment.

ALVA, Keybraille, Minibraille, Mountbatten, Ransley and Braille-n-print are six Human Ware products that were

evaluated. ALVA, Keybraille, Mountbatten, and Braille-n-print, ranked in the top one third of the rankings. The assessor had never worked with any of these pieces of equipment.

The bottom one third of the equipment consisted of graphics software programs (PicTic and Etgraphx), transcription software (Duxbury and TranscriBex), interfacing devices (Ransley), braille printers (Braillo Comet and Braille 400), and equipment without documentation (Provox). Provox, Pictic, Etgraphx, and KTS 40 were included as part of this study because they were listed on the manufacturers price lists, however there was no written information about these products. As a result, the only questions that could be responded to on the assessment were those questions specific to the manufacturer. These pieces of equipment were the only pieces to be ranked in the bottom one third of the equipment across all categories.

The Braille 400 is a braille printer that has been manufactured for commercial braille production. The cost of this printer, as of July 1, 1992, is 77, 995.00 U.S. dollars, which makes it inappropriate for school consideration.

Scaddon (1984) reported that companies can assist the promotion of improved quality of life for individuals with visual impairments in the age of improving technologies. Companies must create software in numerous areas which will

facilitate the interactive use of computers. Transcribex is a computer software package designed for use with the Apple computer. The use of the Apple computer is being replaced in schools by the Mac or IBM computer. This change within schools of computer technology limits the appropriateness of this software package. The effectiveness of the Ransley interface is dependent on the pieces of equipment that it is interfaced with.

Koenig & Holbrook (1989) developed a checklist of student characteristics worth consideration when selecting primary reading medium. The ability to handwrite or print was included on this list. In the student characteristic section, question 3.4 was eliminated because the ability to handwrite is not applicable to students who use braille as a primary medium. The assumption is that specialized equipment designed to facilitate braille production would be used by students who primarily use braille.

Most equipment received a 'not applicable' to question 2.4. which asked about the ability of the student to use the equipment with varying degrees of motor stability. The manufacturers did not offer any information about any of the products with respect to use with motor inabilities and therefore one could only rely on personal experience(s) with the equipment to answer the question.

Questions 4.1, 4.2, 5.2, and 6 in the program characteristics consistently received a not applicable

answer on the evaluation. None of the documentation received from the manufacturers discussed the use of the equipment with direction from a teacher, teacher assistant or consultant. These questions could only be answered if the assessor had experience with the use of the equipment. All of the equipment could be purchased without a referral from a professional trained in the education of students with visual handicaps.

On page one of the technical characteristics, question 1 was not answered, instead the cost of the equipment was listed on the data sheet. These costs have been not been included as part of this study. Although cost is considered in the purchase of technical equipment (Spungin 1985) its importance as a technical characteristic in the assessment tool was minimal. One of the reasons for this was that this question can only be responded to if one knows the prices of all equipment in the field. The costs of the equipment were recorded in the hopes that at the conclusion of the assessment the costs could be used to compare pieces of equipment that were rated similarly. For example, the Braille 'n Speak and the BrailleMate are competitive braille note takers. They both received overall ratings within the top one third. Cost of these pieces of equipment could therefore influence a purchase. In this case the costs of these pieces of equipment is similar. This appeared to be the situation for other pieces of equipment as well.

Question 2.1 was answered 'yes' if the manufacturer made available a demo disc of the product. Questions 2.2 to 3.4 were specific to the manufacturer and therefore the answers were consistent for each piece of equipment listed under a manufacturer.

Questions 12.1 to 14.3 and questions 18.1 to 18.4 were applicable only to large print software and computers and therefore were not answered when braille equipment was being evaluated.

Following the evaluation of braille equipment, large print software and computers were evaluated.

Large print equipment. The process used to evaluate braille equipment was repeated for this category. Seventeen pieces of large print software and computers were evaluated and the results are summarized on Table 7.

Insert Table 7 about here

This equipment was rank ordered from the highest evaluation score to the lowest evaluations in all categories including overall. These ranked scores were divided into three equal divisions of top, middle and bottom ranking. Many of the scores on the list were duplicated and for this reason approximately half of the large print equipment fell into the top portion of the division. Four pieces of equipment (CCTV, Artic Business Focus, The Bright Eye, and

Artic Focus) fell in the bottom portion, and five pieces of equipment (BIG, LP-DOS, Keysoff, Zoomtext, and Verbal View) remained in the middle.

Companies distributing large print equipment included: (a) Computer Conversations; (b) Raised Dot Computing; (c) Microsystems; (d) Frontier Computing; (e) Human Ware; (f) Telesensory Inc.; (g) Optelec; (h) Hexagon; and (i) Artic Technologies. Raised Dot Computing, Microsystems, Human Ware, Telesensory Inc., Optelec, and Artic Technologies, were companies that had equipment in the top portion of the ranking. Frontier computing had both of their products rank in the bottom portion of the division. It is probable that this had occurred as a result of limited documentation sent by the manufacturers and therefore evaluation questions were not answered.

The Bright Eye is a product that appears to be for use by an adult. The pamphlet, sent by the manufacturer, displayed adults using the equipment. The pamphlet described the use and delicate nature of the equipment. There was no information about the use of this equipment in a classroom.

Scholl (1986) reported that as a result of a range and combination of disabilities it is unlikely that any two students will have exactly the same disabilities. This range and variety of disabilities impacts on decisions regarding implementation and use of specialized equipment. Equipment that is versatile, meeting the needs of a variety of

students, needs to be considered as a likely purchase for the classroom. Adapta-Lan is a variety of software products specifically designed to meet the needs of a variety of handicaps. This equipment received the highest rating of any of the pieces of equipment rated.

Three pieces of Human Ware products were evaluated (Mastertouch, Keysoff, and Clearview). Mastertouch and Clearview received ratings which placed them in the top one third of the ranked equipment. Two pieces of Microsystems equipment (MAGic Deluxe and Adapta-Lan), were evaluated and both of these products were rated in the top one third of the ranked equipment. CCTV and Artic Business Focus, the only equipment evaluated from Frontier Computing, were rated in the bottom one third of the products. A price list for Frontier Computing products was the only documentation received for these products. With limited experiences and no documentation, many or all of the evaluation questions were not answered. TeleSensory Inc. products continued to rate highly as they did in the braille section of equipment.

Many of the questions in the general technical characteristics section were not applicable if the equipment being evaluated was software. Questions not applicable included: (a) 4.1, compact in size and light in weight to carry; (b) 4.3, withstand decalibration; (c) 4.4, durability to withstand transport; (d) 4.5, operated without the following...; (e) 4.6, length of the power cord; (f) 4.7,

battery life; and (g) 6, does the purchase include.... These questions are applicable to the equipment that the software will be installed into.

The results of the evaluation of voice equipment has been reported in the following section.

Voice synthesis equipment. The procedure for evaluating equipment was repeated a third time for equipment listed under the voice synthesis category. In total, 24 pieces of equipment were assessed. Summary of results has been included in Table 8.

Insert Table 8 about here

When the voice equipment was listed from the highest ranked score to the lowest ranked score there was a number of repeated values. This repetition of values resulted in ten pieces of equipment listed in the bottom one third, seven pieces of equipment listed in the middle one third, and seven pieces listed in the top one third of the equipment. Four pieces of equipment (Jaws, IBM screen reader, Arkenstone reader, and Accent), from Blazie engineering, were evaluated. Jaws, IBM screen reader, and Arkenstone reader ranked in the top one third of the ranked equipment. It is probable that products ranked in the top one third had documentation that supplied information necessary to facilitate the answering of the evaluation

questions. Products rated in the bottom one third of the ranked equipment typically were products that the manufacturer and/or distributor only sent price listings for or a very sketchy description.

Question 2.1, from the student characteristics section of the assessment tool, asks if this equipment can be used by students who have a hearing disability. Individuals with visual impairments have been using accelerated or compressed speech for many years because of its increased efficiency (Todd, 1986). Typically speech equipment is considered for students with visual impairments and therefore could influence the response to this question.

The information that was received from the manufacturers and/or distributors did not indicate whether or not the equipment could be used without support from a teacher, teacher assistant or consultant. Therefore questions in the program characteristics section of the assessment, specific to amount of support required to use the equipment (4.1, 5.2, and 6), were answered with 'not applicable'. Cronin (1992) suggested, in his evaluation of computers, that equipment that has been adapted for students with visual impairments usually requires input from a staff member. Staff member could be defined as teacher, teacher assistant or consultant.

Robotron did not send information specific to the policies that this company follows and as a result questions

2.2 to 3.4, specific to the policies that manufacturers and/or distributors follow, were not answered. Scadden (1984) reported that manufacturers and/or distributors could assist the promotion of improved quality of life for individuals with visual impairments by offering rental agreements, lease purchase agreements, low interest loans, purchase subsidies, and clearly indicating what the consumer will receive with their purchase. Uslan (1992) suggested that it is important for consumers to have information on warranty, extended warranty, cost of shipping and available technical assistance. Lack of this information lowers the rating of the equipment being evaluated.

Questions from the tech2 section of the evaluation form were not applicable to voice equipment because they were questions specific to large print and braille equipment. Questions 29 and 30 from the tech3 section of the evaluation were the only applicable questions in this section.

SynPhonix, Transport, Keynote, Text Talker, and Echo are pieces of equipment that received ratings in the bottom one third across all categories. These pieces of equipment represented 50% of all of the equipment rated in the bottom one third of the equipment in the total column. Vert Plus and Arkenstone Reader received ratings in the top one third of all categories with the exception of tech2, which was not applicable.

Reliability. The reliability of the assessment tool

developed in this study was established following the procedures outlined in Chapter 3. The overall reliability was 85.3%. This figure was calculated by adding the total percentage of agreements for each product and dividing by the total number of pieces of equipment evaluated. The summary of these results have been listed on Table 9.

Insert Table 9 about here

Reliability ranged from 65.7% to 100%. Those pieces of equipment receiving a rating of 100% agreement did not have information sent from the manufacturers and/or distributors. The only available information was the price. Professional experiences and training of the researcher and the raters were similar. Professional experiences of these individuals included: (a) job description; (b) philosophy; (c) intervention strategies; (d) resources and materials used on the job; (e) use and training in specialized technical equipment; and (f) cliental. Without information on the equipment, the questions on the evaluation were answered with 'not applicable' and the result was 100% agreement of responses. Equipment with 65.7% overall agreement typically were pieces of equipment that the raters and the researcher have had experience with and therefore subjective interpretation affected the manner in which the questions were answered. Although these individuals have similar

professional backgrounds, including use and training of technical equipment, there had been opportunities for exposure to pieces of equipment that the others did not have. These different experiences are as a result of working with students that have a variety of needs. For example, some student clients are very young and are not yet working with any equipment, and other student clients are high school age and are presently using extensive specialized equipment. Some of these students have very good residual vision while others have no vision at all. The need(s) of students dictates the type of equipment that would be used. The student cliental caseloads differ from year to year and therefore experiences with specialized technical equipment reflect the caseload that the individual had.

Rater 1 consistently had fewer agreements, with the researcher, than did rater 2. Rater 1 has had fewer experiences with technical equipment and it is probable that rater 1 relied more on objective evaluation. Rater 1 has a caseload of predominantly preschool children who were not yet using equipment.

The overall percentages for agreements for the braille equipment ranged from 82.5% to 98%. Overall percentages for agreements for large print and voice equipment showed a general tendency to be lower with ranges of 76% to 100% and 65.7 to 100%. Braille equipment can be measured more easily from objective criteria because evaluation criteria includes

format and transcription capabilities of print to braille and braille to print. The standards for this process have already been determined by guidelines for braille transcription certification (Mastering Literary Braille). Voice quality on the other hand is much more subjective and relies on individuals preference.

Products from the same manufacturer tended to have similar reliability ratings percentage. For example products from Telesensory Incorporated received ratings of 86.6%, 85.4%, 87.7%, and 84.5%. It is probable that this occurred because of the consistency and quality of the documentation that the company distributed about their products.

Question 7 and 8, in tech1 section of the assessment, caused confusion for the rater's because comment revealed that they thought of expanding and interfacing capabilities to be associated with the computer and not with software products. For example, they did not consider that some software works independently and other software will only work in the presence of another software package such as a word processing package such as WordPerfect or MicroSoft Word.

The reliability data indicated that this assessment tool can effectively be used, by professionals trained in the education of students with visual impairments, to evaluate technical equipment. The following section discusses the limitations which must be considered for this

study.

Limitations

As a result of the low incidence of visually impaired school-age individuals in Alberta (this figure is influenced by the fact that individuals do not have to register with the Canadian Institute for the Blind or the Multi-Media Resource Center and as a result may not be identified), one of the major limitations of this study were the restrictions which occur because of the limited number of identified distributors. The Multi-Media Resource Center is a facet of the Alberta Government supplying registered students with adaptive technology, and auditory, large print and braille alternatives to print curriculum materials. The majority of information that was collected from distributors was done so through contacts with the United States. Technical equipment for students with visual impairments is not manufactured within Alberta and therefore it is possible that the sample of manufacturers/distributors collected for this study is incomplete. Of those manufacturers/distributors contacted 64% responded to requests for information. As a result, it is probable that many pieces of specialized technical equipment are available and were not identified for evaluation in this study.

The assessment tool was developed from a review of the literature and was not field tested. The reliability of the tool was established with professionals trained in the

education of students with visual impairments. It is not known if the instrument would demonstrate reliability if used by regular classroom teachers or with teaching assistants. Reliability of the instrument was difficult to test because of the amount of time required to review each of the pieces of equipment using all of the evaluation questions. The raters expressed concern over this time factor.

The validity of the instrument was established from subjective evaluation. The panel were asked for their opinions on whether the instrument was appropriately reflecting student, program, and technical characteristics. Establishing validity on the basis of personal experiences limits this study because of the variety of personal experiences.

The assessment tool developed in this study will be limited to use within the population of students with visual impairments. This point is clarified with the following scenario: The Multi-Media Resource Center (MRC) is presently offering service to students registered with them. This service includes access to large print materials, braille materials, audio-materials and technology. In order to be registered with the MRC, a student must have a CNIB registration number. The assessment tool developed in this study could be used to make decisions specific to requests made to the MRC for students with visual impairments. In the

event that the mandate of the MRC changes and the service is expanded to include students with disabilities other than vision, the information gained from the use of the assessment tool would not generalize to these populations. For example, a student with a visual perceptual disability requiring material presented through an auditory medium would find materials at the MRC appropriate for an individual program. The assessment tool developed in this study would not generalize to this population as it has only taken the characteristics of students, programs and specialized equipment for the visual impaired into consideration.

Future Research

A beneficial follow-up to this study would be field testing of the assessment tool. Input from teachers and teacher assistants working with students with visual impairments could provide valuable insight into improvements to the assessment tool. With input from a field study it is possible to develop an instrument that could potentially generalize to other disabilities.

It is hoped that information established from this tool can be shared with manufacturers and/or distributors who develop specialized technical equipment for students with visual impairments. The criteria established in question format within the tool is information that educators need to have when they are making decisions on technology selection

for classroom use. If the manufacturers are aware that this information is important to educators, they are in a position to decide whether or not to include this information in their marketing information.

Conclusion

Most of the equipment evaluated was not known to the researcher and therefore the evaluation questions were answered from the documentation received from the manufacturers and/or distributors. Factors that were found to be important specific to the documentation included: (a) whether or not the equipment was illustrated; (b) if the equipment was clearly described according to its function and essential requirements that must be purchased; (c) whether or not all products are clearly marketed; (d) whether or not the manufacturer and/or distributor had a catalogue or flyers advertising their products; (e) company policies clearly indicated; (f) whether the information was in color or not; (f) information included was relevant to educational placements; and (g) ordering information was clearly indicated.

Cost of the equipment was found to be a factor that was competitive among products and therefore not a factor in selection of appropriate equipment for students.

The assessment tool developed in this research offers benefits to consumers of specialized technical equipment for use by students with visual impairments and to

manufacturers/distributors of this equipment. Manufacturers and/or distributors could use this tool to evaluate new equipment on the market while the consumers could use information, obtained from the use of this tool, to make decisions regarding the purchase of equipment for a student's educational placement.

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TABLES

TABLE 1

Characteristics of the Potential Technology User(s)

1. The functional limitations of the user (blind, or multiply handicapped.
2. The physical and mental capabilities of the user - child adult or aging person, born blind or recently become blind.
3. The user's affinity or preference for the various types of technology, tactile or auditory learner, attractive looking aid or not, age related problems, and adolescence.
4. The user's desire for independence, the loneliness of the elderly, sighted guide means more than mobility.
5. The physical location of the user, geographic and environmental, rural or urban, school, home or work setting.
6. The cooperation or potential occupation of the user.
7. The vocational and avocational aspirations of the user.
8. Income or other funds available - if aid not work - related.
9. Any ways in which the above characteristics might change over time.
10. The specific performance level requirements of the activity/environment in which the individual will be involved.

Note. From

"Corridors of insensitivity: Technology and blind persons" by S. Spungin (1985), Journal of Visual Impairment and Blindness, 79(3), 113-116.

TABLE 2

Use of Computers by Students who use Braille

Success with computer tasks requires that:

1. The QWERTY keyboard (prerequisite to use of computer) is mastered.

2. Commands and terms (such as "center the heading", "tabulate the columns", "insert a space", "move to the end of the line", "set for double-spacing", and "align the paragraph" that students need to learn are based on visual or spatially oriented concepts.

3. Braille-using students understand a print readout and understand the differences between braille and print presentation. This includes an explanation of functions such as bold, overwrite, insert, block and underline.

4. Equipment that is adapted for students with visual impairments usually emanates from agencies that support the students and differs significantly from equipment for sighted students. The selection of braille embossers, voice synthesizers, braille input devices, and software that is specific to visual impairments requires input information.

5. Students require training in the organization and coordination of work materials for computer-oriented tasks. These tasks include:
   -read braille version of assignment;
   -collect appropriate text in braille and taped form;
   -read materials;
   -engage computer and insert software;
   -key in the answer to the assignment;
   -print assignment in braille and in print;

table continues

-staple print answer sheet to print question sheet;
-staple braille answer sheet to brailled question sheet;
-locate the appropriate subject folder;
-return the disc, braille texts, and taped materials.

Note. From "A direct service program for mainstreamed students by a residential school" by P. J. Cronin (1992), Journal of Visual Impairment and Blindness, 86(2), 101-110.

TABLE 3

Evaluation Criteria for Technical Equipment

1. VOICE SYNTHESIS
   * hardware or software review features that allow the user to scan a document, and
   * shut-up features which allow the user to turn off unwanted text

2. REFRESHABLE BRAILLE
   * time of storage and retrieval of information
   * the need for multiple keystrokes to review information
   * the display and ease of reading
   * the need to take one's hands off the keyboard to read
   * the difficulty with conversions between grade 1, 2, 3, and computer braille
   * ability to deal with graphics
   * cost

3. HARDCOPY BRAILLE
   * portability
   * noise
   * quality of output
   * speed
   * continuous feed paper
   * mechanical reliability

4. LARGE PRINT COMPUTERS
   * sufficient magnification
   * amount of material displayed in proportion to page viewing
   * use of task required

5. OPTICAL AIDS
   * accessibility to unmodified computer screen
   * illumination capabilities
   * field size
   * working distance
   * cost

Note. From "Applications of Microcomputers by Visually Impaired Persons" by G. Goodrich (1984), Journal of Visual Impairment and Blindness. 78(9), 408-413.

TABLE 4

Evaluation of Large-Print Computers

a. selling price

b. hardware included

c. software included

d. options

e. keyboard configurations

f. program and data storage

g. display configuration

h. memory configuration

i. interface

j. documentation

k. service location

l. manufacturer

Note. From

"Large-print computers: An evaluation of their features" by D. Morrissette (1984), Journal of Visual Impairment and Blindness, 78(9), 428-434.

TABLE 5

Similarities and Differences between Braille 'N Speak and BrailleMate

SIMILARITIES

*size and weight: appear similar, about the size of a paperback book
*input and output mode: both have braille keyboards for input and speech synthesis for output

DIFFERENCES

*keyboards: BrailleMate (BM), has an eleven-key with slight indentations in each key Braille 'n Speak (BNS), has seven-key with a very sturdy feel to them
*one-cell refreshable braille display present on BM and not the BNS
*ease of use, BM was designed so that cursor movement commands could be issued with either hand so as to allow user to read the single-cell braille display, BS on the other has left hand moving the cursor forwards (potentially) much easier to remember
*use of the editors: BM must move cursor to the end of document before begin new information, while BNS does this automatically; deleting text, using speech to move through text, identification of new paragraphs, insert and delete modes and search function were all compared;
*managing file: includes opening, creating, renaming and copying files. Features of the management of a file that were important to Carter included, ease of learning, power of functions
*prompts help and documentation: verbalization of prompts as opposed to tones to prompt, built in help information, manuals or user documentation
*battery life: BM (six hours), BNS (twelve to sixteen hours)

Note. From "BrailleMate and Braille 'N Speak 640. An Objective Comparison" by R. Carter (1992), Tactic, 8(3), 4-10.

Table 6

Braille Equipment

1 TOP ONE THIRD

2 MIDDLE ONE THIRD

3 BOTTOM ONE THIRD

(Braille Equipment)

EQUIPMENT	STU	PROG	TECH1	TECH2	TECH3	TOTAL
RAISED DOT COMPUTING						
Mega Dots	1	1	2	1	2	1
Hot Dots	1	1	2	1	2	1
TranscriBex	3	3	3	1	2	3
PixCells	3	3	2	1	3	3
G.W. MICRO						
Braille Talk	3	2	2	2	2	2
ROBOTRON						
Eureka A4	3	1	1	1	1	1
KANSYS. INC.						
Turbo Braille 3.0	2	2	3	2	2	2
Provox 4.0	3	3	3	3	3	3
FRONTIER COMPUTING						
Romeo	3	2	2	3	1	2
Juliet	3	2	2	3	1	2
PC Braille "pro-pack"	2	2	3	2	2	3
Duxbury	3	2	3	2	2	3
PicTic	3	3	3	3	3	3
Etgraphx	3	3	3	3	3	3
Braille 'n Speak	1	1	1	1	1	1

EQUIPMENT	STU	PROG	TECH1	TECH2	TECH3	TOTAL
AMERICAN PRINTING HOUSE						
Perkins	1	1	3	3	3	2
BLAZIE						
Blazer embosser	1	1	2	3	1	1
Personal Touch	2	2	1	1	3	1
BEc	2	2	2	2	3	2
Thiel Beta-x3 embosser	2	2	2	3	1	2
PC master	2	2	2	3	3	2
AMERICAN THERMOFORM						
Ohtsuke BT-5000	1	1	3	3	1	2
KTS 40 cell	3	3	3	3	3	3
HUMAN WARE						
ALVA	2	1	2	1	3	1
Keybraille 25 or 45	2	1	2	1	3	1
Minibraille 22	2	2	1	3	3	2
Mountbatten	1	2	2	2	3	1
Ransley (interface)	2	3	3	3	3	3
Braille-n-print	1	1	2	2	3	1
TELESENSORY INC.						
Versapoint	1	2	1	3	3	2
Optacon	2	2	1	2	3	2
OsCaR	1	1	1	2	3	1
Everest DT	2	2	1	3	3	2
BrailleMate	1	1	1	2	1	1
Navigator LX	1	1	1	2	1	1
OPTELEC						
Braillo Comet	3	2	3	3	1	3

EQUIPMENT	STU	PROG	TECH1	TECH2	TECH3	TOTAL
Braille 400	3	3	3	3	1	3

Student characteristic values: 1 = 23-30
2 = 18-22
3 = 0-17

Program characteristic values: 1 = 12-19
2 = 8-11
3 = 0-7

Tech1 characteristic values: 1 = 11-19
2 = 7-10
3 = 0-5

Tech2 characteristic values: 1 = 6-14
2 = 2-4
3 = 0

Tech3 characteristic values: 1 = 3-5
2 = 1
3 = 0

Total characteristic values: 1 = 48-68
2 = 38-47
3 = 0-37

Table 7

Large Print Equipment

1 TOP ONE THIRD

2 MIDDLE ONE THIRD

3 BOTTOM ONE THIRD

(Large Print Equipment)

EQUIPMENT	STU	PROG	TECH1	TECH2	TECH3	TOTAL
COMPUTER CONVERSATIONS						
Verbal View	2	1	3	2	3	2
RAISED DOT COMPUTING						
Zoomtext	2	1	1	2	3	2
Bex 3.1	1	1	2	1	3	1
MICROSYSTEMS						
MAGic Deluxe	2	2	2	2	3	1
Adapta-Lan	1	2	2	1	3	1
FRONTIER COMPUTING						
CCTV-executive -Opteq Vision	3	3	3	3	3	3
Artic Business Focus	3	3	3	3	3	3
HUMAN WARE						
Mastertouch for Gold	2	2	2	3	3	1
Keysoff for Gold	1	2	2	3	3	2
Clearview	1	1	1	2	1	1
TELESENSORY INC.						
CCTV- Vantage CCD - Voyager CCD - Versicolor XL - Chroma XL	1	1	1	2	3	1
OPTELEC						

EQUIPMENT	STU	PROG	TECH1	TECH2	TECH3	TOTAL
20/20	1	1	1	2	3	1
LP-DOS	2	2	2	2	3	2
The Bright Eye	3	3	1	3	3	3
HEXAGON						
BIG for WP	2	1	3	3	3	2
ARTIC TECHNOLOGIES						
Artic Magnum	1	1	1	1	3	1
Artic Focus	3	3	3	2	3	3

Student characteristic values:
1 = 32-41
2 = 25-31
3 = 0-15

Program characteristic values:
1 = 13-19
2 = 11-12
3 = 0

Tech1 characteristic values:
1 = 8-15
2 = 6-7
3 = 0-5

Tech2 characteristic values:
1 = 8-14
2 = 2-6
3 = 0

Tech3 characteristic values:
1 = 14
2 = 13
3 = 0-4

Total characteristic values:
1 = 55-71
2 = 44-53
3 = 0-30

Table 8

Voice Synthesis Equipment

1 TOP ONE THIRD

2 MIDDLE ONE THIRD

3 BOTTOM ONE THIRD

Table 8
(Voice Synthesis Equipment)

EQUIPMENT	STU	PROG	TECH1	TECH2	TECH3	TOTAL
COMPUTER CONVERSATIONS						
VOS Basic	1	2	3	N/A	1	1
Verbette Mark 1	3	3	3	N/A	1	3
Votrax PS	3	3	3	N/A	1	3
Verbal Star	3	3	3	N/A	1	3
XEROX IMAGING						
Bookwise	1	1	2	N/A	1	2
Reading Edge	1	1	2	N/A	1	1
Kurzweil Reader	1	1	2	N/A	1	1
RAISED DOT COMPUTING						
ASAP	2	2	1	N/A	1	2
Omnichron's Flipper	1	2	1	N/A	1	2
G.W. MICRO						
Speak Out	3	3	3	N/A	2	3
Sounding Board	2	3	2	N/A	1	2
Dectalk	3	3	2	N/A	2	3
Echo LC	3	3	3	N/A	3	3

EQUIPMENT	STU	PROG	TECH1	TECH2	TECH3	TOTAL
Vocal Eyes	2	2	2	N/A	1	2
ROBOTRON						
Robotron Text Reader	1	1	2	N/A	1	2
AMERICAN PRINTING HOUSE						
Text Talker	3	3	3	N/A	3	3
BLAZIE						
Jaws	1	2	1	N/A	1	1
IBM Screen Reader	1	2	1	N/A	1	1
Arkenstone Reader	1	1	1	N/A	1	1
Accent	2	2	1	N/A	1	2
HUMAN WARE						
Keynote Gold	3	3	3	N/A	3	3
TELESENSORY INC.						
Vert Plus	1	1	1	N/A	1	1
ARTIC TECHNOLOGIES						
SynPhonix	3	3	3	N/A	3	3
Transport 615	3	3	3	N/A	3	3

Student characteristic values:
1 = 23-31
2 = 5-22
3 = 0

Program characteristic values:
1 = 12-15
2 = 6-11
3 = 0-5

Tech1 characteristic values:
1 = 7-11
2 = 4-5
3 = 0-3

Tech2 characteristic values:
N/A

Tech3 characteristic values:
1 = 2
2 = 1

3 = 0

Total characteristic values:

1 = 43-55
2 = 18-42
3 = 0-7

Table 9

	Student			Program			Technical 1			Technical 2			Technical 3			Overall Total
Possible Arrangments	R1	R2	Av. %	R1	R2	Av.%	R1	R2	Av. %	R1	R2	Av. %	R1	R2	Av. %	%
BrailleMate	13/86	14/93	89.5	9/90	9/90	90	20/80	23/92	86	15/88	14/82	85	13/82	13/82	82	87
Navigator	14/93	14/93	93.0	9/90	9/90	90	18/72	19/76	74	15/88	15/88	88	12/72	15/93	82	85
Mega Dots	12/80	12/80	80.0	9/90	10/100	95	19/76	19/76	76	16/94	15/88	91	13/82	13/82	82	85
Optacon	13/86	13/86	86.0	9/90	9/90	90	21/84	24/96	90	14/82	15/88	85	14/87	14/87	87	88
Thiel	13/86	14/93	89.5	8/80	9/90	85	19/76	20/80	78	14/82	15/88	85	13/82	14/87	84.5	85
Minibraille	12/80	13/86	83.0	7/70	8/80	75	20/80	22/88	84	14/82	16/94	88	13/82	13/82	82	83
Versapoint	13/86	13/86	86.0	7/70	8/80	75	22/88	22/88	88	15/88	15/88	88	13/82	14/87	85.5	85
Braille Comet	15/100	15/100	100	10/100	10/100	100	25/100	25/100	100	18/100	18/100	100	15/93	14/87	90	98
20/20	12/80	13/86	83.0	7/70	8/80	75	20/80	21/84	82	13/76	14/82	79	11/68	13/82	75	79
Mastertouch	13/86	14/93	89.5	8/80	9/90	85	22/88	24/96	92	14/82	16/94	88	13/82	14/87	84.5	88
CCTV	15/100	15/100	100	10/100	10/100	100	25/100	25/100	100	17/100	17/100	100	16/100	16/100	100	100
LPDOS	11/74	12/80	77.0	6/60	8/80	70	20/80	21/84	82	12/70	13/76	73	11/68	14/87	77.5	76
Vos Basic	10/66	11/74	70.0	5/50	6/60	55	15/60	17/68	64	10/59	10/59	59	12/75	13/82	78.5	66
Vert Plus	11/74	12/80	77.0	7/70	8/80	75	17/68	19/76	72	11/65	13/76	70.5	12/75	12/75	75	74
Robotron	13/86	14/93	89.5	7/70	8/80	75	18/72	20/80	76	14/82	15/88	85	13/82	14/87	84.5	82
Verbette	15/100	15/100	100	10/100	10/100	100	25/100	25/100	100	17/100	17/100	100	16/100	16/100	100	100
Echo	14/93	15/100	96.5	9/90	9/90	90	23/92	24/96	94	15/88	15/88	88	14/87	15/93	90	92

APPENDICES

APPENDIX 1

MATRIX INCLUDING STUDENT, PROGRAM AND EQUIPMENT CHARACTERISTICS

APPENDIX 1

Matrix including Student, Program and Equipment Characteristics

	EVALUATION TOOL FOR TECHNICAL AIDS	
STUDENT CHARACTERISTICS	PROGRAM CHARACTERISTICS	TECHNICAL CHARACTERISTICS
1. Age	A. Curricula 1. Grade levels	A. General Characteristics 1. Cost (competitive with other equipment offering the same function)
2. Disabilities 2.1. Auditory 2.2 Visual 2.3. Fine motor development 2.4. Motor stability of the arms, head and trunk 2.5. academic performance 2.6. prognosis 2.7. congenital blindness	2. Subject areas (language arts, math, social studies, science, phys.ed., options)	2. Purchase of equipment 2.1. is it available as a loaner? 2.2 is there a payment plan? 2.3. is there a warranty? 2.4. is there an extended warranty? (including cost for recurring operational supplies)

	EVALUATION TOOL FOR TECHNICAL AIDS	
STUDENT CHARACTERISTICS	PROGRAM CHARACTERISTICS	TECHNICAL CHARACTERISTICS
3. Abilities 3.1. grade level reading (vocabulary) 3.2 grade level of writing (vocabulary) 3.3. follow directions, one part, two part or three part 3.4 ability to handwrite or print	3. Production of materials 3.1. produce materials that the teacher has created in the appropriate medium 3.2. can the teacher or student input these materials creating a file for the students use at a later date	3. Purchase package (what is included?)
4. Specialized Skills 4.1. previous experience with technical equipment 4.2. previous training 4.3. braille	<u>B. Teacher</u> 4. Teacher involvement 4.1. student use without teacher 4.2. teacher use equipment without training in braille, synthetic speech, computers, general use of the equipment	4. Technical Support 4.1. ongoing technical support from the company 4.2. available 800 number to the consumer 4.3. location and proximity of service centers 4.4. who pays for shipping? 4.5. can basic maintenance of the equipment (cleaning, organizing power source(s), replacing paper and so on) be managed by the student?

	EVALUATION TOOL FOR TECHNICAL AIDS	
STUDENT CHARACTERISTICS	PROGRAM CHARACTERISTICS	TECHNICAL CHARACTERISTICS
	5. Consultant involvement 5.1. purchased without assessment 5.2. equipment utilized without assistance from consultant	5. Physical Management 5.1. compact enough to be carried 5.2. compact enough to be stored 5.3. durability of the equipment when used by child 5.4. durability of the equipment when carried or transported 5.5. does this equipment need accessories (table, special chair, shelf and so on) 5.6. length of power cord 5.7. battery life
	6. Teacher assistant support (can the equipment be used with varying levels of teacher assistant support)	6. Training 6.1. manufacturer provide the opportunity to be trained in the use of the equipment 6.2. manufacturer provide special curriculum for use by the classroom teacher

	EVALUATION TOOL FOR TECHNICAL AIDS	
STUDENT CHARACTERISTICS	PROGRAM CHARACTERISTICS	TECHNICAL CHARACTERISTICS
	C. Instructional Methods 7. Use of the equipment in individual or group environments	7. Expansion (allow for other pieces of equipment to be used with it)
		8. Interfacing or networking capabilities of this equipment
		9. Facilitating independence for the student through the management of their own materials, rather than have a teacher assistant managing for them
		10. Facilitating the placement into the least restrictive environment for the student because of noise (does the student have to be removed to use the equipment?)
		11. Facilitating the production of age appropriate curriculum materials for the student

	EVALUATION TOOL FOR TECHNICAL AIDS	
STUDENT CHARACTERISTICS	PROGRAM CHARACTERISTICS	TECHNICAL CHARACTERISTICS
		B. Input Characteristics Large Print Software and Computers 12.1. Review feature (look back at info that has been put into the computer) 12.2. Single key-stroke to complete functions 12.3. Retrieve info in less than 2 sec. 12.4. Save info in less than 2 sec. 12.5. Complete most functions in less than 2 sec. 12.6. Equipment allow for use of graphics 12.7. Possible to choose font(s) 12.8. Information for help (pull down help menu or manual)
		13. Modifications 13.1. (Is it possible to adjust cursor size and speed?) 13.2. allow for an adapted keyboard

	EVALUATION TOOL FOR TECHNICAL AIDS	
STUDENT CHARACTERISTICS	PROGRAM CHARACTERISTICS	TECHNICAL CHARACTERISTICS
		14. Magnification 14.1. magnify without changing clarity 14.2. magnification of field (more than half of what is being viewed) 14.3. choices of field viewing
		<u>Braille Software</u> 15. Braille code 15.1. software have the ability to change braille into print 15.2. software have the ability to format braille correctly
		16. Modification of the cursor (turn the cursor off while reading refreshable braille, so that the student can read through text without getting lost)
		17. Input braille into the computer and read print on the screen

	EVALUATION TOOL FOR TECHNICAL AIDS	
STUDENT CHARACTERISTICS	PROGRAM CHARACTERISTICS	TECHNICAL CHARACTERISTICS
		B. Output Characteristics Computer Screen 18.1. minimize glare 18.2. minimize clutter 18.3. color on the screen 18.4. good contrast 18.5. allow the student to adjust light intensity
		Refreshable braille 19. hands left on the display while reading
		20. height of the dots
		21. color of the dots in contrast to the encasement of the display
		Braille printer 22. ability to format braille appropriately
		23. noise
		24. variety of paper size and weight
		25. continuous feed paper
		26. accompanied with speech
		27. speed
		28. braille on the control buttons

	EVALUATION TOOL FOR TECHNICAL AIDS	
STUDENT CHARACTERISTICS	PROGRAM CHARACTERISTICS	TECHNICAL CHARACTERISTICS
		<u>Voice synthesis</u> 29. quality of voice
		30. ability to shut the speech off

APPENDIX 2

EVALUATION TOOL

APPENDIX 2

Evaluation Tool

QUESTIONS	YES	NO	N/A
STUDENT CHARACTERISTICS			
1. Can this equipment be used with the following age groupings? a. 0-6 b. 7-12 c. 13-18 d. adults e. elderly (over 65)			
2.1. Can this equipment be used by students who are: a. profoundly deaf? b. deaf? (hearing disability preludes successful processing of linguistic information through audition, with or without a hearing aid)			
2.2. Can this equipment be used by students who are: a. totally blind? b. partially sighted? (by definition students with a visual acuity of 20/200 in the best corrected eye or a restricted field of less than 10 degrees, tunnel vision) c. colour blind?			

QUESTIONS	YES	NO	N/A
2.3. Can this equipment be used by students who: a. have fine motor development that restricts their performance to most basic of fine motor skills such as using one finger to push the power button to the on or off position b. have fine motor development that enables them to flip the power button but they would have difficulty with keyboarding skills even if the keyboard was modified c. fine motor development that creates difficulty manipulating a regular keyboard because of motor dysfunction but would be able to manage if the equipment were modified to accommodate this)			
2.4. Can this equipment be used by students who: a. do not have motor stability in their arms (the arms of the student are unsteady, as well there may be some involvement with muscle tension, too tight or not enough tension) b. do not have adequate control of head movement (ex. the head moves uncontrollably or the individual is unable to hold head upright; lack of head control may interfere with vision and eye-hand controL) c. do not have motor stability of their trunk (the trunk is not strong enough to support the weight of the body and therefore the student is unable to sit or is only able to sit for very short periods of time)			
2.5. Can this equipment be suitable for students who perform within these academic divisions: a. above grade level b. grade level c. below grade level			

QUESTIONS	YES	NO	N/A
2.6. Would this equipment continue to be functional to a low vision student who will experience progressive vision loss?			
2.7. Can this equipment be used if the student has never had any sight?			
3.1. Would this equipment be suitable for students who can read material at: a. level of letter recognition only; b. grade one to three level; c. grade four to six level; d. junior high level; e. high school level.			
3.2. Would this equipment be suitable for students who can write material at: a. level of letter recognition only; b. printed words, grade one to three; c. written/printed words, grade four to six; d. written/printed words at secondary level (grade seven to twelve)			
3.3. Can this equipment be used by students who demonstrate the ability to: a. follow a one step direction (for example; turn on the computer) b. follow two step directions: (for example; turn on the computer and open a file) c. follow three step directions: (for example; turn on the computer, open a file, and write a sentence)			
3.4. Would this equipment be suitable for use by students who do not have the ability to write or print?			

QUESTIONS	YES	NO	N/A
4.1. Would this equipment be suitable for use by students who: a. have never used technical equipment of any kind b. have had exposure to technical equipment such as a tape recorder, film projector, computer. (Exposure refers to limited use of the technology. The technology may be present in the classroom and the student may have had the opportunity to look at it or perhaps perform some very elementary tasks. The students in this category would be familiar with some terminology and basic function) c. have used the equipment and have regular access to it			
4.2. Would this equipment be suitable for use by students who: a. have not had any formal training in the use of technical equipment b. have received instruction in one or more technical items, not necessarily the item being considered c. have received instruction in more than two technical items			
4.3. Would this equipment be suitable for use by students who: a. do not read braille b. read only grade one braille (Grade one braille is one braille cell representing one print letter, a very elementary level of braille reading) c. read grade two braille, and are considered good braille readers			
COMMENTS:			

QUESTIONS	YES	NO	N/A
PROGRAM CHARACTERISTICS			
A. Curricula			
1. Would this equipment be suitable for use in the following grade levels: a. grade one to three b. grade four to six c. grade seven to twelve d. post secondary			
2. Would this equipment be suitable for use in the following subject areas: a. language arts -word processing -spelling -note-taking -reading b. math c. social studies d. science e. physical education f. options (art, drama, music, French)			
3.1. Can this equipment output computer files, that have been generated by teachers for use with students, in the following mediums: a. braille; b. large print; c. print (12 point); d. voice synthesis?			
3.2. Can this equipment input materials in a choice of mediums: a. braille; b. large print; c. print (12 point); d. voice? (A choice is necessary if the teacher, using print, and the student, using braille, both use the equipment to input information)			
B. Teacher			
4.1. Can the student use this equipment without involvement from a teacher?			

QUESTIONS	YES	NO	N/A
4.2. Can the teacher use this equipment without training in skills specific to students with visual impairments? For example: knowledge of braille instruction, training in recognition of synthetic speech, training in positioning of documents under a CCTV.			
5.1. Can this equipment be purchased without a referral from a professional trained in the education of students with visual handicaps?			
5.2. Can this equipment be used without involvement from a professional trained in the education of students with visual handicaps?			
6. Can this equipment be used without the involvement of teacher assistant support: a. full-time (assigned to students with a visual impairment on a full-time basis); b. part-time (assigned to students with a visual impairment on a part-time basis, which means that the aide is only in the classroom for half of the day or less, minimum 10 hours per week); c. part-time (teacher assistant is assigned to the classroom on a full time basis but to the student with a vision loss for a part-time portion of the placement. This would mean a second adult may be available to assist with technical equipment).			
C. Instructional Methods			
7. Can this equipment be used by students: a. in center activities where students are working independently; b. as part of a group activity (lecture, or group discussion).			
COMMENTS:			

QUESTIONS	YES	NO	N/A
TECHNICAL CHARACTERISTICS			
1. When compared with other pieces of equipment, that offer the same function, is the cost of this equipment lower?			
2.1. Is this equipment available as a loaner? a. to expose the equipment prior to purchase; b. to replace equipment that has to be sent away for repair; c. demo disc.			
2.2. Does the manufacturer offer a payment plan to the consumer?			
2.3. When compared with other pieces of equipment, that offer the same function, is the warranty on this equipment for a longer period of time?			
2.4. Does the manufacturer offer the choice of purchasing an extended warranty?			
3. When this equipment is purchased does it include: a. software; b. carrying case; c. blank discs; d. battery; e. extra battery; f. an adapter; g. cables? (for example to hook up a printer)			
4.1. Does the consumer have access to ongoing technical support in the event that the equipment requires some immediate troubleshooting?			
4.2. Is technical support available from an 800 number?			

QUESTIONS	YES	NO	N/A
4.3. Does the manufacturer offer alternatives for repair or maintenance, other than the home base? (For example: If a Canadian consumer purchases the equipment in the United States but can have it repaired in Canada there may be advantages such as less hassle, packaging for shipping less complex, time that equipment is away may be less)			
4.4. Does the company pay to have the equipment shipped for repair?			
4.5. Can this equipment be maintained by students? (for example: is the equipment designed in such a way that the student can be taught to independently take care of the equipment. This could involve such tasks as organizing the power cords into the correct terminals, covering the equipment when it is not in use, taking the equipment out of a storage case and setting it up, dusting or cleaning of equipment)			
5.1. Is this equipment compact in size and light in weight so that it can be easily carried by a child?			
5.2. Does the size of this equipment allow for storage within a classroom? For example: if the equipment was set up on a desk, or fit onto a shelf or into a cupboard its size allows for storage within the classroom.			
5.3. Is the durability of this equipment sufficient to resist decalibration if it is carried by 6 - 12 years old?			
5.4. Is the durability of this equipment sufficient to withstand transport in crowded school hallways on an audio-visual cart?			

QUESTIONS	YES	NO	N/A
5.5. Can this equipment be operated without the following: a. extra table space; b. access to power source; c. shelving; d. additional light source; e. specialized desk; f. special chair?			
5.6. Is the length of the power cord more than one meter? Within the structure of a classroom the distance between a students desk and a power source is typically one meter or more.			
5.7. Is the battery life of this equipment documented at three hours, or more? Three hours is approximately the duration of one half of a school day and therefore a three hour battery life would allow the student to use the equipment for the duration of this time without access to a power source.			
6.1. Does the manufacturer provide opportunities for training in the use of the equipment for: a. the student; b. the teacher-aide; c. the teacher?			
6.2. Can the consumer purchase curricula from the manufacturer? Specialized equipment is purchased to facilitate integration into the regular classroom. It would be helpful to educators to have curricula developed which would offer guidelines on the use of the specialized equipment in the regular classroom. This curricula would include objectives specific to the use of the equipment as well as how to use the equipment to meet grade specific classroom objectives.			

QUESTIONS	YES	NO	N/A
7. Does this equipment allow for expansion? For example, if at a later date the user wanted to add additional features to the equipment such a external sound or increased memory size?			
8. Does this equipment allow the student to interface or network with other pieces of equipment? For example: a PC interfacing to a braille printer and/or a print printer?			
9. Does the use of this equipment facilitate independence for the student by allowing the student to interact directly with the teacher through the exchange of materials? (For example: in a classroom environment the teacher hands materials to the students, they complete the work and hand it back to the teacher for correction. If one of these students uses braille as a primary medium, the student must receive the print material from the teacher and with the use of the technology transcribe this material into a braille format, complete the work, transcribe the work back into print to be handed into the teacher).			
10. Can this equipment be used in the classroom environment without interfering with the performance of the other children? (For example; noise of the equipment)			
11. Does the equipment facilitate equal access, with normal functioning student to grade appropriate curriculum materials?			
COMMENTS:			

QUESTIONS	YES	NO	N/A
INPUT CHARACTERISTICS OF THE FOLLOWING CATEGORIES: - LARGE PRINT SOFTWARE AND COMPUTERS - BRAILLE SOFTWARE			
LARGE PRINT SOFTWARE AND COMPUTERS			
12.1. Does this equipment have review features that allow the student to review information that has been input?			
12.2. Does this equipment require a single keystroke to complete most functions?			
12.3. Does this equipment retrieve stored information, within 2 seconds?			
12.4. Does this equipment save information within two seconds?			
12.5. Does this equipment complete all or most functions within two seconds?			
12.6. Does this equipment allow the student to use graphics?			
12.7. Does this equipment have choices for size of font? (For example; 12, 18, 24, 48 or 72 point print size)			
12.8. Does this software include information about the functions of the equipment (help information) that can be accessed through a function key? (For example if the student is not familiar with the software and wants to know about moving text, he /she can access the information by pushing a function key or he/she will have to look up the information in a manual)			
13.1. Does this equipment allow the student to adjust: a. the rate of the cursor movement b. the size of the cursor			

QUESTIONS	YES	NO	N/A
13.2. Does the equipment allow for a: a. keyboard that has been adapted for size by enlarging and spacing the keys b. keyboard that has changed its shape in some to way to accommodate a disability			
14.1. Does this equipment magnify the image without changing the clarity of the image?			
14.2. Does this equipment display more than half of the material being viewed? For example: when a student places a full page of print under the CCTV, are they able to view more than half of the printed page on the screen.			
14.3. Does this equipment offer choices of field size for viewing? For example: are there adjustments on the equipment that allow the student to adjust the field size.			

QUESTIONS	YES	NO	N/A
BRAILLE SOFTWARE			
15.1. Does this software have the ability to transcribe (change) braille input into print output? a. at the braille grade one level (one Braille cell, a configuration of six dots, represents one print letter); b. at the braille grade two level (Braille has been developed as a code to reduce the volume of paper needed to reproduce print documents into braille format. This code allows for one braille cell to represent an entire word or portion of a word in print. For example if the student were reading grade two braille and came across the braille letter 'k' standing alone, the student would know that the 'k' in this situation represents the word knowledge. A print copy of this document would print the braille 'k' as knowledge.			
15.2. Does this software have the ability to format (includes indenting, centring, bolding, margins, tabs and so on) material that has been input: a. as grade one braille b. as grade two braille			
16. Does this software allow the student to turn off the cursor in order to search through text? (pertains to the use of refreshable braille, the student can turn the cursor off and read through the braille display without losing their place)			
17. Does this software allow the student to view the braille input as print on the screen? a. an entire screen at a time b. a line at a time c. three words at a time			

QUESTIONS	YES	NO	N/A
OUTPUT CHARACTERISTICS FOR: - COMPUTER SCREENS - REFRESHABLE BRAILLE DISPLAY - BRAILLE PRINTERS - VOICE SYNTHESIZERS			
COMPUTER SCREENS			
18.1. Has the manufacturer modified this equipment to minimize screen glare?			
18.2. Does this equipment offer a colour screen?			
18.3. Does this equipment minimize clutter of the field? (For example; is information on the screen in a format that is easy for the student to follow such as menus across the top of the screen)			
18.4. Does this equipment provide variation in colour contrasting figure-ground relationship?			
18.5. Does this equipment allow the student to adjust the light intensity of the screen?			
REFRESHABLE BRAILLE DISPLAY			
19. Does the equipment allow the braille user to leave their hands on the braille display to read and still maintain contact with the function keys?			
20. Does the refreshable braille display raise the dots sufficiently so that the student can distinguish each of the braille cells clearly? A refreshable braille display is a braille display that continually changes. These changes are possible because tiny pins move up and down forming braille cells which have been input into the computer. If these pins are not raised high enough from the plastic encasement the reader has a difficult time distinguishing the change from cell to cell.			

QUESTIONS	YES	NO	N/A
21. Are the pins of the refreshable braille display a different colour from the plastic encasement? If they are the same colour as the encasement the teacher-aide or teacher will not be able to determine which pins of the braille cell are raised. Without this information, the material on the display can not be read visually.			
BRAILLE PRINTERS			
22. Does this equipment format a print copy into a document that outputs as a braille copy, displaying accurate format rules?			
23. Does this equipment run with less noise than equipment of similar function?			
24. Does this equipment allow for a variety of paper use, weight and/or size?			
25. Does this equipment allow for continuous paper feed?			
26. Does this equipment have synthetic speech output?			
27. When compared to other printers capable of the same function is this printer faster?			
28. Does this printer have the function keys marked in braille?			
VOICE SYNTHESIS			
29. Is the quality of the synthetic speech understood without training? For example: a person listening to the speech would be able to understand it without someone teaching them how to interpret it.			
30. Does this equipment have shut-up features that allow the student to turn off synthetic speech?			
COMMENTS:			

APPENDIX 3

LETTER TO MANUFACTURERS

APPENDIX 3
Letter to Manufacturers

To Whom it May Concern,

I am a graduate student at the University of Alberta, Canada. My research project involves the evaluation of current technology that the visually impaired individual has access to. Technologies that I am specifically interested in fall within the following categories: speech systems and speech software, braille printers, braille notetakers, braille display, translating programs, scanners, and large print programs.

My intention during this project is twofold. First, to determine the educational needs of the visually impaired student, and needs of the programs to which they belong. Secondly, I intend to develop a number of categories which describe attributes of the technology, and list costs, types of resource assistance and support and training involved for user and teacher. This collection of information will be formulated into an evaluation chart which each piece of technology will be placed.

In order for me to represent your products correctly, I would appreciate a current price list and any additional information regarding the specifications of the technology that you market.

Thank you very much for your assistance with this project. If you have questions or comment regarding this project, I would be pleased to address them.

Yours truly,

Dianne McConnell
Graduate Student
University of Alberta

67 Woodside Crescent
Spruce Grove, Alberta
Canada
T7X 3E6

Home # (403) 962-8128

APPENDIX 4

ADDRESSES OF MANUFACTURERS

APPENDIX 4

Addresses of Manufacturers

Artic Technologies
55 Park Street
Troy Michigan
48083
313-588-7370
fax: 313-588-2650

Telesensory
P.O. Box 7455
Mountainview, CA
94039-7455
415-960-0920
fax: 415-691-0637

Human Ware Inc.
6425 King Road
Loomis, CA 95659
300-722-3393
fax: 916-652-7296

G.W. Micro
310 Racquet Drive
Fort Wayne, IN 46825
219-483-3625
fax:219-484-2510

Blazie Engineering
3660 Mill Green Road
Street, MD 21154
301-879-4944

Henter Joyce Inc.
10901-C Roosevelt Boulevard
Suite 1200
St. Petersburg, FL. 33716
813-576-5658
fax: 813-577-0099

Computer Conversations
6297 Worthington Road S.W.
Alexandria, OH 43001
614 924-2885

KanSys. Inc
1016 Ohio Street
Lawrence, KS
66044
913-843-0351

Omnichron
1438 Oxford Street
Berkeley, CA 94709
415-540-6455

Raised Dot Computing
408 S. Baldwin Street
Madison, WI 53703
608-257-9595

Edupro Software Ltd.
P.O. Box 308
St. Albert, Alberta T8N 1N3
403-458-0303

Aicom Corporation
1590 Oakland Road
Suite B112
San Jose, Ca 95031
408-453-8251

Digital Equipment Corporation
146 Main Street
Maynard, MA 01754
508-897-5111

Personal Data Systems
100W Rincon Avenue
Suite 217
Campbell, CA 95008
408-866-1126

American Thermoform Corp
2311 Travers Avenue
City of Commerce, CA 90040
213-723-9021

Index Inc.
4420- Norledge Street
Kansas City, MO 64123
800-421-9775

American Printing House for the Blind
1839- Frankfort Avenue
P.O. Box 6085
Louisville, Kentucky 40206-0085
502-895-2405

Hexagon Products
P.O. Box 1295
Park Ridge, IL 60068-1295
708-692-3355

Optelex Canada
715 Delage, Suite 900
Longueuil. Quebec J4G 2P8
514-677-1171

Microsystems Software Inc.
600 Worcester Road
Famingham, MA. 01701-5342
508-879-9000

Seeing Technologies Inc.
7074 Brooklyn Blvd.
Minneapolis, MN. 55429
800-462-3738

A1 Squared
1463-Hearst Drive N.E.
Atlanta, GA. 30319
404-233-7065

Syntha Voice Computers Inc.
125 Gailmont Drive
Hamilton, Ontario L8K 4B8
416-578-0565

Lyon Computer Discourse Ltd.
1009 Kinloch Ln.
N. Vancouver, B.C. V7G 1V8
604-929-8886

The Aroga Group
1405 Bewicke Ave.
North Vancouver, B.C.
V7M 3C7
604-986-7999

Integrated Assistive Technologies
1257 Michigan Dr.
Coquitlam, B.C.
V3B 6T7
604-464-8245

Xerox Imaging Systems, Inc.
9 Centennial Drive
Peabody, MA 01960

Frontier Computing
250 Davisville Avenue, Suite 205
Toronto, Ontario M4S 1H2
(416)489-6690

APPENDIX 5

MATRIX OF POSSIBLE EQUIPMENT TO BE EVALUATED

APPENDIX 5

Matrix of Possible Equipment to be Evaluated

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
COMPUTER CONVERSA-TIONS				
		VOS Basic-a speech output software	Verbal View-enlarges print on the screen	
		VOS	Large Print Dos	
		Verbette Mark I	LP DOS Deluxe Edition with graphics	
		Verbette Mark II		
		Votrax Personal Speech System (PSS)		
		RS232 Cable (needed for Type-and Talk, PSS, and DECtalk Speech synthesize		
		Verbal Star		
XEROX IMAGING				

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
		BookWise		
		The Reading Edge		
		Kurzweil Personal Reader		
		PC/KPR		
RAISED DOT COMPUTING				
		Double Talk PC		
	MegaDots-transcription program (braille to print)	ASAP -classic -portable -soft	ZoomText	
	HotDots 3.0	Omnichron Flipper-combined with: adapter, symphonix, braille 'n speak, DECtalk, internal DECtalk card, Assent, Echo PC	BEX (large print software for Apple II computers) -also a braille translator into Grade one or Grade two, support braille output	
	TranscriBEX	AppleWorks companion-software which gives speech	BEX 3.1 has proDos bridge built in	

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
	pixCELLS-helps you create graphics		MathematiX turns BEX to allow verbal or inkprint from Nemeth Code	
MICRO-SYSTEMS SOFTWARE INC.				
			MAGic Deluxe and MAGic	
			HandiWORD-limited keyboarding ability	
			Adapta-Lan	
G.W. MICRO				
		Speak-Out with 25 pin PC serial cable (external synthesize		Small Talk PC-four choice

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
		Sounding Board (internal synthesize for PC computers) sounding board LT for Toshiba- sounding board XE- for Toshiba		Desk-top PC- seven choice
		DECtalk		
		ECHO II		
		ECHO LC		
		Vocal Eyes		
		Vocal Eyes with Dragon/ Voicetype		
		Speak-Out Voice Package		
		DECtalk PC Voice package		
		Laptop voice package		
		Laptop XE voice package		
	Braille talk			Calcwor thy

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
	OSCAR Devices- Open book Open book (deluxe) open book (unbound) Hewlett Packard ScanJet llp Scanner Hewlett Packard ScanJet llc Scanner Arkenstone Hot Reader At Plus Arkenstone Automatic Document Feeder Arkenstone Hand Reader Hot/At Arkenstone Hand Scanner Sheet Feeder			Noteworthy
				Note worthy and Calc- worthy Combo
				LP-Dos
				Word Per- fect
				calc- talk
				file- talk

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
				talk speller
				term-talk
				word-talk
				work-station pro
ROBOTRON (IAT)				
	Eureka A 4 (braille note taker)	Robotron Text Reader 320		
KANSYS. INC.				
	Turbo Braille 3.0			
	Auto Braille 1.1A			
	Provox 4.0			
	Provox 4.0			
	Provox combo #1			
	Provox combo #2			
FRONTIER COMPUTING				

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
	Printers: Romeo RB20 brailler Romeo RB40 brailler Juliet Brailler (interpoint) Romeo external keypad sound cover for Romeos (small) sound enclosure (large)	Aicom		

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
	Translators: PC Braille "pro-pack" PC braille PC sift WP sift Duxbury Duxbury braille translator/ Ms-DOS Duxbury braille translator/ MacIntosh Duxbury Software upgrade of above Duxbury nemeth math code supplement/ MS-DOS Duxbury translator for WordPerfect /MS-DOS Graphic Translators: PicTic Etgraphx			

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
	Note takers: Braille 'n Speak SpeakSys program		CCTV: Executive Vs-II Opteq Vision System	Computers: AIC IBM AST Toshiba Ultratech Printers: Canon (Desktop and Portables) Citizen Epson Fujitsu Hewlett Packard IBM Panosonic Star
			Artic Business Focus/Magnum GT	
AMERICAN PRINTING HOUSE FOR THE BLIND				
	Perkins Brailler			
		Texttalker		
		Texttalker GS		
		Spea-qualizer (Braille and Large Print		

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
BLAZIE				
	Braille 'n Speak Braille 'n Speak 640 Braille 'n Speak SNAP-PAC Braille 'n Speak Disc Accessory Braille Blazer Embosser Personal Touch PCMASTER	JAWS- Job Access with Speech	Franklin Language Master 6000 SE	
	Bee	JAWS Form-Mate		
	Read-to-me	IBM Screen Reader		
	Thiel Beta-x3 Embosser	ASAP		
	Porta-Thiel	Arkenstone Reader		
	Etgraphx	Arkenstone Open Book		Pana-sonic printer
	PixCELLS	Vocal Eyes		Citizen printer
	Duxbury	Accent -PC -MC -SA -MINI -TOSHIBA		Hp jet printer
	BEX	Adapter Speech System		Dis-conix printer

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
	Hot Dots	Prose 4000		Palm printer
	Megadots	DecTalk		
		Sounding Board		
		Double Talk		
AMERICAN THERMO-FORM				
	Ohtsuki BT 5000			Thermo-form Machine (s)
	Braillo Comet			
	Braillo 200			
	Braillo 400			
	KTS Braille Display			
HUMAN WARE				
	ALVA	Keynote Gold	Mastertouch	Solid Gold Printer
	Romeo 20 or 40		Clearview	Printer (s) variety
	KeyBraille 25 or 45		Viewpoint VGA	
	Minibraille			
	Mountbatten			
	Ransley Interface			

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
	Braille-n-print			
TELE-SENSORY INC.				
	Versapoint braille printer	Vert Plus	CCTV(s)	
	Optacon	Personal Vert		
	OsCar	outSpoken		
	Everest DT			
	MPrint			
	Braille-Mate			
	Navigator			
	Telebraille			
OPTELEC				
	Braillo Comet		20/20	E-Z Form
	Braille 200		LP-DOS	Maxi-Form
			The Bright Eye	
HEXAGON				
			BIG for WP	
			B-Edit	
ARTIC TECH-NOLOGIES				
		SynPhonix	Artic Magnum	

COMPANY	BRAILLE	VOICE	LARGE PRINT	OTHER
		Transport	Artic Business Focus	FOCUS- VISION

APPENDIX 6

SAMPLE DATA SHEET

Equipment	1 abcde	2.1 ab	2.2 abc	2.3 abc	2.4 abc	2.5 abc	2.6	2.7	3.1 abcde	3.2 abcd	3.3 abcde	3.4	4.1 abc	4.2 abc	4.3	total

APPENDIX 7

RAW DATA

Legend

. = yes response

n/a = not applicable or don't know

x = no response

Equipment	1 abcde	2.1 ab	2.2 abc	2.3 abc	2.4 abc	2.5 abc	2.6	2.7	3.1 abcde	3.2 abcd	3.3 abcde	3.4	4.1 abc	4.2 abc	4.3	total
BRAILLE																
Mega Dots			x	xx	xxx					x		n/a	x	x	x	26
Hot Dots					n/a					n/a		n/a	x	x	x	26
TranscriBex			n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4
PicCells			xx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8
Braille Talk			n/a	n/a	n/a	n/a		x				n/a			n/a	17
Eureka		n/a		n/a	n/a		x		n/a	n/a		n/a				16
Turbo Braille		n/a			n/a		n/a	n/a	n/a	n/a		n/a				16
Provisi	price only															
Romeo		n/a	n/a		n/a		n/a		n/a	n/a		n/a			x	17
Juliet		n/a	n/a		n/a		n/a		n/a	n/a		n/a			x	17
Pc Braille			n/a		n/a		n/a		n/a	n/a		n/a			x	22
Duxbury			n/a		n/a		n/a		n/a	n/a		n/a			xx	17
PicTic	price only															
Etigraphx	price only															
BNS		xx		xx	xxx		n/a		n/a	n/a		n/a			x	23
Perkins					n/a		n/a		n/a	n/a		n/a				20
Blazer embosser					n/a		n/a		n/a	n/a		n/a				20
Personal Touch					n/a		n/a		n/a	n/a		n/a				22
BEc		n/a			n/a		n/a		n/a	n/a		n/a				18
Thiel		n/a			n/a		n/a		n/a	n/a		n/a				19
Pc Master					n/a		n/a		n/a	n/a		n/a				19
Ohtsuki Bt 5000					n/a							n/a				20

KTS	price only															
ALVA	...	..	.	.	n/a	..	x	.	n/a	n/a	...	n/a	..	..	..	19
Keybraille	....	..	.	.	n/a	..	x	.	n/a	n/a	...	n/a	..	..	..	19
Minibraille	....	..	xx	xx	x	....	x	.	n/a	n/a	...	n/a	..	..	..	21
Mountbatten	.....	..	xx	xx	x	....	x		n/a	n/a	.....	n/a	....	....	....	26
Ransley	.....	..	n/a	n/a	n/a	....	x	n/a	...	...	.....	n/a	..	..	n/a	22
Braille-n-print	.....	..	xx	xx	x	....	x	.	n/a	n/a	.....	n/a	....	....	....	27
Versapoint	....	..	...		n/a	....	x	.	n/a	n/a	...	n/a	....	....	....	24
Optacon	....	..	...	n/a	n/a	....	x	.	n/a	n/a	...	n/a	..	..	..	21
OsCar	....	..	...	.	x	..	.	.	....	.....	...	n/a	....	..	..	30
Everest	....		...		x	..	n/a	.	n/a	n/a	...	n/a	....	....	..	22
BrailleMate	x....	x	...		x	....	x	.	n/a	n/a	...	n/a	....	....	..	23
Navigator	x....		...		x	..	x	.	n/a	n/a	...	n/a	....	....	....	23
Braille Comet	cost prohibitive															
Braille 400	....			.	n/a	n/a	x		n/a	n/a	...	n/a	....	..	..	17
LARGE PRINT																
Verbal view	x....		x	n/a	n/a	....	x	x	.....	.....	.....		n/a	n/a	n/a	25
Zoomtext	x....		x	n/a	n/a	....	x	x	x....	x....	.....		n/a	n/a	n/a	25
Bex 3.1	x....		....	xx	n/a	....			x....	x....	.....		....	....	....	36
MAGic Deluxe	x....		x	xx	n/a	....	x	x	x....	x....	.....		x	....	x	30
Adapta-Lan	.....		...	...	...	....	.	x	...	...	...		....	....	n/a	41
CCTV	price only															
Artic Focus	price only															
Mastertouch	x....		x	xx	n/a	....	x	x	....	.....	.....		x	....	n/a	31
Keysoft	....		x	xx	n/a	....	x	x	....	.....	.....		x	....	n/a	33

Clearview			x	xx	xxx		x	x							n/a	34
CCTV (TSI)			x	xx	n/a		x	n/a							n/a	33
20/20			x	xx	n/a		x	n/a							n/a	34
LP-DOs			x	xx	n/a		x	x							n/a	30
BIG			x	xx	n/a		x	x	x	x		n/a	x		n/a	28
Artic Magnum			x	xx	n/a		x	x					x		n/a	32
Artic Focus (AT)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	x	x	n/a		x		n/a	14
VOICE EQUIPMENT																
VOS		n/a			n/a							n/a			n/a	28
Verbette Mark	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Votrax PS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Verbal Star	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Bookwise		n/a			n/a		n/a	n/a		n/a		n/a			n/a	23
Reading Edge		n/a			n/a		n/a	n/a		n/a		n/a			n/a	23
Kurzweil Reader		n/a			n/a		n/a	n/a		n/a		n/a			n/a	23
ASAP		n/a			n/a				n/a	n/a		n/a				22
Omnichron's Flipper		n/a			n/a				n/a	n/a		n/a				23
Speak Out	price only															
Sounding Board	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		n/a			n/a	6
Dectalk	price only															
Echo	price only															
Vocal Eyes		n/a		n/a	n/a	n/a		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5
Robotron text		n/a			n/a							n/a				23
Text talk	price only															

Jaws	.....	n/a	..	.	n/a	....	..	n/a	....	.....	.....	n/a	....	...	n/a	31
IBM Screen Reader	....	n/a	...	.	n/a	...	.	.	...	...	.....	n/a	...	...	...	31
Arkenstone Reader	...	n/a	...	.	n/a	..	.	.	..	...	...	n/a	..	..	..	23
Accent	...	n/a	n/a	.	n/a	..	n/a	n/a	..	n/a	..	n/a	..	..	n/a	13
Keynote Gold	price only															
Vert Plus	....	n/a	....	...	n/a	...	.	.	.....	.....	...	n/a	...	..	.	30
SynPhonix	price only															
Transport 615	price only															

Equipment	1 abcd	2 abcdef	3.1 abcd	3.2 abcd	4.1	4.2	5.1	5.2	6 abc	7 ab	Total 27
BRAILLE											
Mega Dots	...	...	..	..	x	x	.	x	n/a	.n/a	12
Hot Dots	...	...	..	..	x	x	.	x	n/a	.n/a	12
TranscriBex	.	..	.	.	x	x	x	x	x	x	5
PixCells	..	.	.	.	x	x	.	x	n/a	.	7
Braille Talk	...	...	...	.	x	x	.	x	n/a	.	12
Eureka	....	.....	....	..	x	x	.	x	n/a	..	19
Turbo Braille	...	...	..	.	x	x	.	x	n/a	x	10
Provox	price only										
Romeo	..	...	.	n/a	x	x	.	x	n/a	.	8
Juliet	..	...	.	n/a	x	x	.	x	n/a	.	8
Pc Braille	..	...	.	.	x	x	.	x	x	x	8
Duxbury	..	...	.	.	x	x	.	x	x	x	8
PicTic	price only										
Etgraphx	price only										
BNS	....	.....	...	.	.	x	.	x	n/a	..	18
Perkins	....	.....	.	.	.	x	.	x	n/a	..	16
Blazer embosser	....	....	.	n/a	.	x	.	x	n/a	.	12
Personal Touch	...	...	.	.	x	x	.	x	x	..	11
BEc	..	...	..	n/a.	x	x	.	x	.	.n/a	11

Thiel	...	....	.	n/a	.	x	.	x	n/a	.	11
Pc Master	..	...	.	..	x	x	.	x	x	.n/a	10
Ohtsuki Bt 5000	..	...	...	..	x	x	.	x	x	.	12
KTS	price only										
ALVA	..	...	...	..	x	x	.	x	n/a	..	13
Keybraille	..	...	...	..	x	x	.	x	n/a	..	13
Minibraille	..	...	..	.	x	x	.	x	x	.	10
Mountbatten	..	...	..	.	x	x	.	x	x	.	10
Ransley	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Braille-n-print	....	...	..	.	x	x	.	x	x	..	13
Versapoint	..	..	...	..	x	x	.	x	x	.	11
Optacon	..	..	...	..	x	x	.	x	x	.	11
OsCar	..	..	....	...	x	x	.	x	x	.	13
Everest	..	..	...	..	x	x	.	x	x	.	11
BrailleMate	x...	x.....	...	.	xx	x	.	x	x	..x	17
Navigator	...	...	..	..	x	x	.	x	x	.	12
Braille Comet	...	....	.	.	x	x	.	x	x	x	10
Braille 400	..	...	.	.	x	x	.	x	x	x	8
LARGE PRINT											
Verbal view	....	...	.	.	n/a	.	.	.	n/a	.n/a	13
Zoomtext	....	...	.	.	n/a	.	.	.	n/a	.n/a	13
Bex 3.1	....	....	...	...	.	.	.	x	.xx	.n/a	19
MAGic Deluxe	....	...	.	.	n/a	.	.	x	n/a	.n/a	12
Adapta-Lan	....	...	.	.	n/a	n/a	.	n/a	n/a	.n/a	11

CCTV	price only										
Artic Focus	price only										
Mastertouch	....	...	.	.	n/a	.	.	n/a	n/a	.	12
Keysoft	....	...	.	.	n/a	.	.	n/a	n/a	.	12
Clearview	....	.....	.	.	.	.	.	n/a	n/a	..	17
CCTV (TSI)	....	.....	.	.	.	.	.	x	n/a	..	17
20/20	....	.....	.	.	.	.	.	x	n/a	..	17
LP-D0s	....	...	.	.	x	.	.	x	n/a	.n/a	12
BIG	....	...	.	.	x	.	.	.	n/a	.n/a	13
Artic Magnum	....	...	.	.	x	.	.	.	n/a	.n/a	13
The Bright Eye	n/a										
VOICE EQUIPMENT											
VOS	...	...	..	.	x	x	.	x	n/a	.	11
Verbette Mark	n/a	n/a	n/a	n/a	n/a	n/a	.	x	n/a	.	2
Votrax PS	n/a	n/a	n/a	n/a	n/a	n/a	.	x	n/a	.	2
Verbal Star	n/a	n/a	n/a	n/a	n/a	n/a	.	x	n/a	.	2
Bookwise	...	...	.	.	.	.	.	.	n/a	.	13
Reading Edge	...	...	.	.	.	.	.	.	n/a	..	14
Kursweil Reader	...	...	.	.	.	.	.	.	n/a	.	13
ASAP	...	...	.	.	x	x	.	x	n/a	.	10
Omnichron's Flipper	...	...	n/a.	n/a	n/a	x	.	x	n/a	.	9
Speak Out	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	1

Sounding Board	n/a	n/a	..	.	x	x	.	x	x	.	5
Dectalk	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	1
Echo	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	1
Vocal Eyes	.	.	.	.	x	x	.	x	n/a	.	6
Robotron text	..	...	.	.	.	.	.	.	n/a	.	12
Text talk	price only										
Jaws	....	...	.	.	x	x	.	x	n/a	.	11
IBM Screen Reader	...	...	.	..	x	x	.	x	n/a	.	11
Arkenstone Reader	..	...	....	....	x	x	.	x	n/a	.	15
Accent	..	...	.	.	x	x	.	x	n/a	.	9
Keynote Gold	price only										
Vert Plus	....	...	.	..	x	x	.	x	n/a	.	12
SynPhonix	price only										
Transport 615	price only										

Equipment	1	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	4.1	4.2	4.3	4.4	4.5	4.6	4.7	5.1	5.2	6	7	8	9	10	11	Total
BRAILLE																										
Mega Dots	?							x											x							7
Hot Dots	?							x											x							7
TranscriBex	?																									
PicCells	?							x											x							7
Braille Talk	?	x			x	x	x	x	x									x	x							7
Eureka	?																		x							5
Turbo Braille	?	x	x	x	x													x	x							5
Provox	p/o																									
Romeo	?	x	x			x	x	x	x		x		x		x				x	x	x			x		9
Jubet	?	x	x			x	x	x	x		x		x		x				x	x	x			x		9
Pc Braille	?	x	x			x	x	x	x																	0
Duxbury	?																									
PicTic	?																									
Etigraphx	?																									
BNS	?	x	x			x	x	x	x										x	x						15
Perkins	?	x	x	x	x	x	x	x	x	x	x		x	x	x			x	x	x	x	x	x	x	x	1
Blazer embosser	?	x	x	x				x	x										x	x			x			10
Personal Touch	?	x	x	x				x	x										x	x			x			14
BEc	?																									
Thiel	?																									
Pc Master	?																									
Chitubo Bt 5000	?																									

KTS	?																												
ALVA	?																												
Keybraille	?																												
Minibraille	?																												
Mountbatten	?																												
Ramsey	?																												
Braille-n-print	?																												
Versapoint	?																												
Optacon	?																												
OxCar	?																												
Everest	?																												
BrailleMate	?																												
Navigator	?																												
Braille Comet	?																												
Braille 400	?																												
LARGE PRINT																													
Verbal view	?																												
Zoomtext	?																												
Bes 31	?																												
MAGic Deluxe	?																												
Adaptalan	?																												
CCTV	?																												
Artic Focus	?																												
Matterhorn	?																												
Keysoft	?																												
Classview	?																												
CCTV (TSI)	?																												

2020	?																												
LP-Elite	?																												
BIG	?																												
Artic Magnum	?																												
Artic Focus (AT)	?																												
VOICE EQUIPMENT																													
VDS	?																												
Verbatim Mark	?																												
Vidtex PS	?																												
Verbal Star	?																												
Bordeaux	?																												
Reading Edge	?																												
Kurzweil Reader	?																												
ASAP	?																												
Omnichron's Pepper	?																												
Speak Out	?																												
Sounding Board	?																												
Dectalk	?																												
Echo	?																												
Vocal Eyes	?																												
Robotron text	?																												
Text talk	?																												
Jaws	?																												
IBM Screen Reader	?																												
Arkenstone Reader	?																												
Accent	?																												
Keynote Gold	?																												

Vert Plus	?		
SynPhono	?		
Transport 815	?		

Equipment	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	13.1	13.2 abc	13.3 ab	14.1	14.2	14.3	15.1 ab	15.2 ab	16	17 abc	total
BRAILLE																			
Mega Dots	.	n/a	n/a	n/a	n/a	x	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	..	..		.	6
Hot Dots	.	n/a	n/a	n/a	n/a	x	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	..	..		.	6
TranscriBex	n/a	n/a	m/a	n/a	n/a	x	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	..	..		.	6
PixCells	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	..	..		.	7
Braille Talk	n/a	n/a	n/a	n/a	n/a	x	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	..	..		.	4
Eureka	.	.	n/a	n/a	n/a	x	x	.	n/a	n/a	n/a	n/a	n/a	n/a	..	..	x	n/a	7
Turbo Braille	n/a	n/a	n/a	n/a	n/a	x	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	..	..	x	n/a	4
Provox	price only																		
Romeo																			
Juliet																			
Pc Braille	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	..	..	x	n/a	4
Duxbury	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	..	..	x	n/a	4
PicTic																			
Etgraphx																			
BNS	.	.	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	..	..	x	x	7
Perkins	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Blazer embosser	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Personal Touch	.	.	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	..	..	n/a	n/a	7
BEc	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	..	..	n/a	n/a	4
Thiel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0

Pc Master	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Ohtsuke Bt 5000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
KTS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
ALVA	.	.	.	.	.	n/a	n/a	.	n/a	.	.	n/a	n/a	n/a	..	..	.	.	14
Keybraille	.	.	.	.	.	n/a	n/a	.	n/a	n/a	.	n/a	n/a	n/a	..	..	n/a	n/a	11
Minibraille	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Mountbatten	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	x	x	2
Ransley	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Braille-n-print	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	x	x	2
Versapoint	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Optacon	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	x	x	2
OsCar	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	.	x	3
Everest	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
BrailleMate	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	.	x	3
Navigator	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	.	.	4
Braille Comet	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Brailler 400	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
LARGE PRINT																			
Verbal view	n/a	.	n/a	n/a	n/a	x	.	n/a	n/a	n/a	n/a	.	.	n/a	n/a	n/a	n/a	n/a	4
Zoomtext	n/a	.	n/a	n/a	n/a	x	.	n/a	n/a	.	n/a	.	.	.	n/a	n/a	n/a	n/a	6
Bex 3.1	.	n/a	.	.	.	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	.	.	.	n/a	n/a	8
MAGic Deluxe	n/a	n/a	n/a	n/a	n/a	.	.	n/a	n/a	.	n/a	.	.	.	n/a	n/a	n/a	n/a	6
Adapta-Lan	n/a	.	n/a	n/a	n/a	.	.	n/a	n/a	.	..	.	.	.	n/a	n/a	n/a	n/a	9
CCTV	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0

Artic Focus	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Mastertouch	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Keysoft	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Clearview	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	.	n/a	n/a	.	.	.	n/a	n/a	n/a	n/a	5
CCTV (TSI)	n/a	n/a	n/a	n/a	n/a	.	.	n/a	.	n/a	n/a	.	.	.	n/a	n/a	n/a	n/a	6
20/20	n/a	n/a	n/a	n/a	n/a	.	.	n/a	.	n/a	n/a	.	.	.	n/a	n/a	n/a	n/a	6
LP-DOs	.	.	n/a	n/a	n/a	x	.	.	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4
BIG	n/a	n/a	n/a	n/a	n/a	n/a	x	n/a	n/a	x	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Artic Magnum	.	.	.	.	.	.	.	.	n/a	...	n/a	.	.	.	n/a	n/a	n/a	n/a	14
Artic Focus (AT)	.	.	.	.	.	x	.	.	n/a	...	n/a	.	.	.	n/a	n/a	n/a	n/a	13

TECHNICAL CHARACTERISTICS PART 3

Equipment	18.1	18.2	18.3	18.4	19	20	21	22	23	24	25	26	27	28	29	30	total
BRAILLE																	
Mega Dots	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1
Hot Dots	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1
TranscriBex	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1
PixCells	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Braille Talk	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	x	.	1
Eureka	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	.	.	3
Turbo Braillen/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1
Provox	price only																
Romeo	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	.	.	n/a	.	n/a	n/a	5
Juliet	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	.	.	n/a	.	n/a	n/a	5
Pc Braille	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Duxbury	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1
PicTic	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Etgraphx	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
BNS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	n/a	n/a	n/a	n/a	n/a	.	.	3
Perkins	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Blazer embosser	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	x	.	.	.	x	x	n/a	n/a	3
Personal Touch	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
BEc	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Thiel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	.	.	.	n/a	n/a	n/a	5
Pc Master	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0

Ohtsuke Bt 5000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	.	.	n/a	n/a	x	n/a	n/a	3
KTS	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
ALVA	n/a	n/a	n/a	n/a	.	.	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3
Keybraille	n/a	n/a	n/a	n/a	.	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2
Minibraille	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Mountbatten	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Ransley	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Braille-n-print	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Versapoint	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Optacon	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
OsCar	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Everest	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
BrailleMate	n/a	n/a	n/a	n/a	.	.	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	.	5
Navigator	n/a	n/a	n/a	n/a	.	.	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3
Braille Comet	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Braille 400	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	n/a	.	.	n/a	n/a	n/a	n/a	n/a	3
LARGE PRINT																	
Verbal view	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Zoomtext	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Bex 3.1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
MAGic Deluxe	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Adapta-Lan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
CCTV	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Artic Focus	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0

Mastertouch	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Keysoff	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Clearview	.	.	.	.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4
CCTV (TSI)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
20/20	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
LP-D0s	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
BIG	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Artic Magnum	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Artic Focus (AT)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
VOICE EQUIPMENT																	
VOS															.	.	2
Verbette Mark															.	.	2
Votrax PS															.	.	2
Verbal Star															.	.	2
Bookwise															.	.	2
Reading Edge															.	.	2
Kursweil Reader															.	.	2
ASAP															.	.	2
Omnichron's Flipper															.	.	2
Speak Out															.	x	1
Sounding Board															.	.	2
Dectalk															.	x	1
Echo															x	n/a	0

Sounding Board	n/a	n/a	..	.	x	x	.	x	x	.	5
Dectalk	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	1
Echo	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	.	1
Vocal Eyes	.	.	.	.	x	x	.	x	n/a	.	6
Robotron text	..	...	.	.	.	.	.	.	n/a	.	12
Text talk	price only										
Jaws	....	...	.	.	x	x	.	x	n/a	.	11
IBM Screen Reader	...	...	.	..	x	x	.	x	n/a	.	11
Arkenstone Reader	..	...	....	....	x	x	.	x	n/a	.	15
Accent	..	...	.	.	x	x	.	x	n/a	.	9
Keynote Gold	price only										
Vert Plus	....	...	.	..	x	x	.	x	n/a	.	12
SynPhonix	price only										
Transport 615	price only										

EQUIPMENT				
BRAILLE		LARGE PRINT	VOICE	
KTS	Mega Dots	Verbal View		VOS Basic
ALVA	Hot Dots	Zoomtext		Ver-bette
Key-Braille	Tran-scribex	Bex		Votrax
Mini-Braille	pixCell	MAGic Deluxe		Verbal Star
Mount-Batton	Braille Talk	Adapta-Lan		Book-wise
Ransley	Eureka A4	CCTV: Executive		Reading Edge
Braille-n-print	Turbo Braille	Artic Business	Omni-chron Flipper	Kurz-weil Reader
Versa-point	Provox	Mastertouch	Syn-Phonix	ASAP
Optacon	Romeo	Clearview		
OsCar	Juliet	CCTV	Vert Plus	Speak Out
Everest	PC Braille	20/20	Arken-stone Reader	Sound-ing Board
Ohtsuke	Duxbury	LP-DOS	Accent	Dectalk
Braille-Mate	PicTic	The Bright Eye	Keynote Gold	Echo LC
Naviga-tor	Braille 'n Speak	BIG	IBM Text Reader	Vocal Eyes
Braillo Comet	Perkins	Artic Magnum	Trans-port	Robo-tron
Braillo 400	Blazer	Artic Focus		Text Talker
Et-graphx	PT Master			Jaws
	Bec			

GLOSSARY OF TERMS

VISUAL IMPAIRMENT: a visual disability which even with correction, adversely affects a child's educational performance. (p.29) Scholl

TRANSCRIBE: the process by which braille is interpreted and and written into print, this process is also reversed, interpreting print and brailling it as hardcopy braille

TACTILE EXPLORATION: the process of exploring or touching, usually with the hands.

BRAILLE: a code consisting of configurations of six raised dots that represents print.

LARGE PRINT: print size of 18pt or larger

REFRESHABLE BRAILLE: braille dots that respond to computer signal and therefore continually change as the input into the computer changes.

ORIENTATION AND MOBILITY: the ability to conceptualize where you are with respect to the surrounding environment and navigator your way around that environment.

HARDCOPY BRAILLE: a braille copy that is read from paper

GRADE ONE BRAILLE: one braille cell represents one print letter.

GRADE TWO BRAILLE: one braille cell may represent several print letters or an entire word. This shorting of the print copy is known as contractions. Contractions and rules for their use,make up the braille code.